CONGRUENCE AND ITS ROLE IN MANUFACTURING STRATEGY: AN AUDIT OF GOALS AND SYSTEMS

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ABSTRACT

This thesis is concerned with the realisation of manufacturing strategies. It describes the development and testing of a structured methodology which can be used to determine some of the reasons why a firm may be unable to implement its manufacturing strategy. The methodology is known as a "congruence audit".

It is widely accepted that manufacturing strategies are important, but little has been written about how they should be developed and implemented. In the literature which does exist, however, a key theme is consistency, with many authors arguing that strategies can only be realised through consistency of decision making and action.

Given that people are ultimately accountable for most of the decisions and actions taken in an organisation, it can be argued that consistency of decision making and action might best be achieved if; (a) there is widespread empathy with the organisation's strategic goals (goal congruence), and (b) the organisation's signalling systems - especially those concerned with goal setting, performance measurement, feedback and reward - induce decision making and action which is consistent with these goals (system congruence).

This research set out to test two propositions:

(a) **That a process which can be used to identify areas of either goal or system incongruence (a congruence audit) can be developed.**

(b) **That such a process can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy.**

There were three main phases to the research. Phases one and two involved the development and testing of processes for identifying areas of either goal or system incongruence. Phase three involved the integration of these processes and the application of the resultant congruence audit. In total four companies participated directly in the study. Managers from a further fourteen were consulted.

The key findings can be summarised under the categories of content and process. In terms of content, the data gathered during the congruence audits indicate that the level of goal congruence is highest between a firm's senior managers and those employees who work on the shop floor. Furthermore they suggest that the way in which the goal setting, performance measurement, feedback and reward systems influence employees, varies both from firm to firm and across the organisation's hierarchy. Most importantly, they imply that one of the main reasons firms are unable to realise their manufacturing strategies is that senior managers often inadvertently encourage their subordinates to pursue courses of action which are inappropriate.

In terms of process, the congruence audit serves as a structured means of:

-Defining what a management group believes manufacturing should be doing.

-Identifying what other employees think manufacturing actually is doing.

-Establishing whether any mismatches in perception occur.

-Determining whether such mismatches in perception are a function of the organisation's goal setting, performance measurement, feedback or reward systems.

-Provoking debate so that the issues raised can be resolved.

It should be noted that as this thesis focuses on the development and testing of a process within a limited set of firms, further research is required to confirm the findings and to explore whether the congruence audit can be used more widely.

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For mum

My greatest regret is that you will never read this.

CHAPTER 1: INTRODUCTION

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> "'Would you tell me, please, which way I ought to go from here?'
>
> 'That depends a good deal on where you want to get to,' said the Cat.
>
> 'I don't much care where - ' said Alice.
>
> 'Then it doesn't matter which way you go,' said the Cat.
>
> ' - so long as I get somewhere,' Alice added as an explanation."
>
> (Carroll, 1984, 75).

Many people appear to believe that strategies and plans are synonymous (Andrews, 1971; Ansoff, 1986). In reality, however, strategies are more complex than plans because they evolve as decisions are made and courses of action are pursued (Mintzberg, 1978). Take Nissan, for example, where the intended business strategy is "to build profitably the highest quality car sold in Europe" (Gibson, undated). If the purchasing manager at Nissan were independently to decide to buy low cost, low quality components then Nissan could end up following a strategy radically different to the one it had planned to adopt.

This hypothetical example highlights the importance of consistency and illustrates how strategies are realised as decisions are made and courses of action are pursued at different levels in organisations. Indeed it has been argued that a strategy can only be said to exist when one can identify a consistent pattern of decisions and actions within a firm (Mintzberg, 1978).

The significance of consistency has long been acknowledged in the manufacturing strategy literature. Skinner (1974b, 37), for example, suggested that a manufacturing company should contain a "powerfully aimed, focussed, designed infrastructure in which every element of the system attempts to accomplish the same unique performance criteria".

Hayes and Schmenner (1978) argued that it should be possible to determine what a firm's manufacturing strategy is, simply by examining which proposals it consistently rejects. And Wheelwright (1984) said that the quality of a firm's manufacturing strategy is a function of the consistency:

-between the manufacturing and business strategy;

-among the manufacturing and other functional strategies;

-among the decision categories which make up the manufacturing strategy;

-between the manufacturing strategy and the business environment.

Despite the widespread recognition of the importance of consistency, however, little effort has been devoted to the exploration of whether the concept can be used in a practical setting - particularly with respect to the human side of manufacturing management. Indeed, as Hayes, Wheelwright and Clark observe:

> "much of the writing about manufacturing managers and management tends to focus on the success or failure of certain key decisions, such as the choice among competing process technologies, plant locations, and capital investments. [But] as every experienced manager knows... a handful of "right" decisions plays only a relatively small part in making a company ultimately successful. To be effective, decisions must be interpreted by and implemented through people - people who are often geographically distant from one another, have different skills, job descriptions, educational backgrounds, career expectations, and who sometimes speak different languages. Somehow the strength, intelligence, and allegiance of this mass of diverse individuals must be harnessed and directed toward the common goals. Therefore, the most critical task confronting a senior manager is not simply to acquire the best resources and make the right decisions but to build and operate through a purposeful organisation" (Hayes, Wheelwright and Clark, 1988, 96).

The research reported in this thesis sought to determine whether a structured methodology (a congruence audit) based on the concept of consistency could be used to identify some of the reasons why a firm may be unable to implement its manufacturing strategy. Given that people are ultimately accountable for most decisions and actions taken in an organisation, then writers on organisational culture would claim that to ensure consistency of decision making and action, and hence realisation of strategies, an organisation's strategic goals should be widely shared (Ouchi, 1981; Pascale and Athos, 1981). Business strategists and organisational behaviourists, on the other hand, would argue that consistency of decision making and action can be induced through the use of strategic controls or performance management systems (Bevan and Thomson, 1991; Child, 1985; Erban, 1989; Fowler, 1990; Goold and Quinn, 1990; Hrebiniak and Joyce, 1984; Lorange, 1982; Pugh et al, 1988).

Intuitively both of these views are appealing and the key assumptions underpinning this work are that consistency of decision making and action, and hence realisation of strategies, might best be achieved if:

(a) **There is widespread empathy within the firm with the organisation's strategic goals. This is goal congruence.**

(b) **The organisation's signalling systems - especially those concerned with goal setting, performance measurement, feedback and reward - induce decision making and action which is consistent with the organisation's strategic goals. This is system congruence.**

The research set out to test two propositions:

(a) **That a process, which can be used to identify areas of either goal or system incongruence (a congruence audit) can be developed.**

(b) **That such a process can be used to identify some of the reasons why a firm may be unable to realise its**

manufacturing strategy.

The research aims were as follows:

(a) **Develop and test a process (a goal congruence audit) which can be used to identify areas of goal incongruence.**

(b) **Develop and test a process (a system congruence audit) which can be used to identify areas of system incongruence.**

(c) **Integrate these two processes to form a congruence audit which can be used to identify areas of either goal or system incongruence.**

(d) **Establish whether the congruence audit provides a structured means of identifying some of the reasons why a firm may be unable to implement its manufacturing strategy.**

The remainder of this thesis has been divided into seven chapters. In this first chapter the assumptions underpinning the work, the research propositions and the research aims have been documented. The core concepts of goal and system congruence have also been defined.

In chapter two the literature relevant to this thesis - including that on business strategy, manufacturing strategy, organisational culture and organisational behaviour - is reviewed.

In chapter three the main themes that emerged during the literature review are summarised and the conceptual framework underling the research is presented. Following this, the research propositions are restated and the research methodology is described. The purpose of chapter three, then, is to formally document the link between the literature and the research.

Chapters four and five are devoted to a description of the development and testing of the processes used to identify areas of either goal or system incongruence. In chapter six, the knowledge gained during the piloting of these processes is used to develop a congruence audit, and the data gathered during the two case studies in which it was applied are presented. The purpose of chapters four, five and six is to present the field work.

In chapter seven the issues raised by this research are discussed as the congruence audit is appraised.

Finally, in chapter eight, the key findings of the research are documented and possible areas for future work are identified.

CHAPTER 2: LITERATURE REVIEW

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2.0: Introduction

The aim of the research reported in this thesis was to establish whether a structured methodology based on the concept of consistency (a congruence audit) could be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy. Prior to the development and testing of the congruence audit, however, it was necessary to answer the following questions:

-What is manufacturing strategy?

-How are manufacturing strategies developed and realised?

-What might inhibit the realisation of a manufacturing strategy?

-What related issues are raised in other streams of literature such as that on business strategy, organisational behaviour and organisational culture?

Each of these questions will be addressed in this chapter. We will begin by looking at the literature on business strategy as this is widely accepted as being richer than that on manufacturing strategy (Adam and Swamidass, 1989; Anderson and Schroeder, 1991; Summer et al., 1990). Next we will turn to the literatures on organisational behaviour and organisational culture as these raise some pertinent issues. Then we will review the manufacturing strategy literature. Finally we will discuss the specific studies that relate directly to the research reported in this thesis.

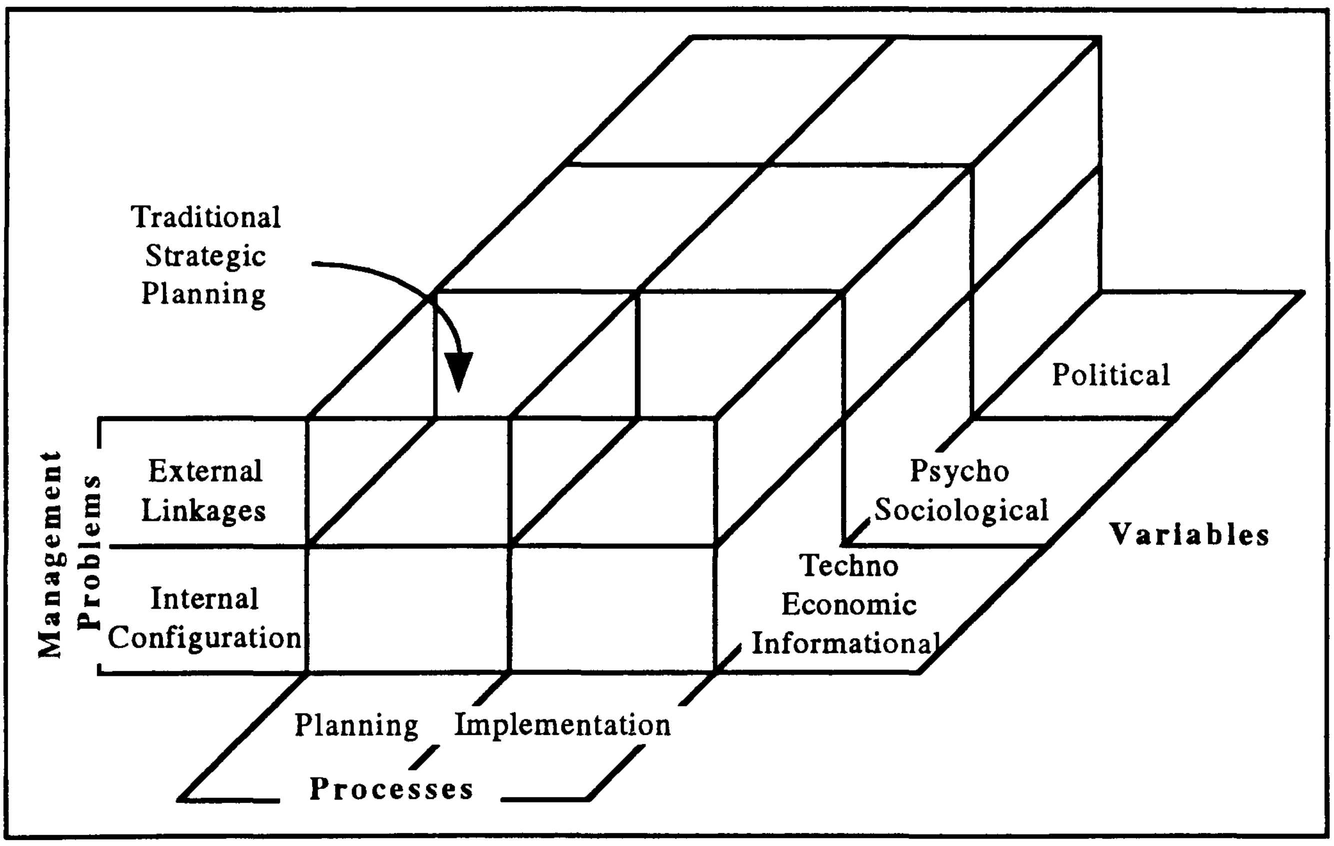
2.1: Business strategy

The term strategy is derived from the Greek word strategos meaning the art of a general (Galbraith and Kazanjian, 1986) and, in the field of business management, is typically defined as:

> "the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals" (Chandler, 1962, 13).

The earliest true form of strategy, strategic planning, was developed primarily by industrialists in the early 1950s as they became increasingly concerned that their firms were failing to meet the requirements of the market place (Ansoff et al., 1976). Strategic planning involved a rational analysis of both the firm and the environment within which it operated. The purpose of the former was to identify the organisation's strengths and weaknesses, while the latter was designed to highlight the opportunities and threats inherent in the market place. Ultimately the objective of these analyses was to find ways in which the firm could use its strengths to exploit opportunities while minimising its weaknesses and hence vulnerability to threats (Andrews, 1971).

Figure 2.1: The modern strategic problem (Ansoff et al., 1976)



As figure 2.1 shows traditional strategic planning focuses on external linkages, planning (problem solving) and technological, economic and informational variables only. Nowadays these elements are seen as but a part of a wider strategic problem that also encompasses issues such as how should a firm be configured internally so that it is best able to offer what is required by the market, how can the strategy implementation process best be controlled, and what psychological, sociological and political variables need to be considered when formulating and implementing a strategy (Ansoff et al., 1976). As this wider strategic problem became more apparent, strategic planning was replaced by strategic management, which has been described as:

> "A more complete way of managing a business concerned not only with markets and decision making, but also with social developments, implementation and the fit of strategy with organisational structure and climate" (Hussey, 1990, 5).

Papers on strategy are often categorised according to whether they focus on what should be addressed in a strategic debate - the content literature - or how strategies should be developed and implemented - the process literature - (Fahey and Christensen, 1986; Huff and Reger, 1987; Leong et al., 1990; Voss, 1992). Many of the early writers on strategy, notably Ackoff (1970), Andrews (1971) and Ansoff (1986), saw the process of strategy formulation as a logical one in which plans were developed and then implemented. However Mintzberg (1978), among others, has argued that this view fails to recognise the true complexity of the process as it assumes that strategies are always formulated explicitly, developed consciously and purposefully, and made in advance of the decisions to which they apply. Support for Mintzberg's thesis is provided by Bailey and Johnson (1992), Bourgeois and Brodwin (1984), Hart (1992) and Mills (1993), all of whom point out that a variety of strategy development and deployment processes, other than the traditional planning model, are presented in the literature. The most common being entrepreneurial, adaptive and ideological.

The entrepreneurial mode of strategy formulation has its roots in the economics literature. Strategies developed using this approach are imposed on the organisation by a minority of its members (Mintzberg, 1978). Hart (1992) labels this the command mode and says that it usually involves top management setting direction for everyone else.

The adaptive paradigm is based on the work of Lindblom (1959), although he coined the phrase "the science of muddling through". Quinn (1980) uses the expression "logical incrementalism" in the same context and suggests that under this mode managers have a view of where they want the organisation to be and continually take small evolutionary steps toward it.

The third strategy process paradigm, the ideological one, is synonymous with Prahalad and Hamel's concept of strategic intent (1989). Mintzberg and Waters (1985) summarise this mode of strategy formulation as follows:

> "When members of an organisation share a vision and identify so strongly with it that they pursue it as an ideology, then they are bound to exhibit patterns in their behaviour, so that clear realised strategies can be identified. These may be called ideological strategies" (Mintzberg and Waters, 1985, 262).

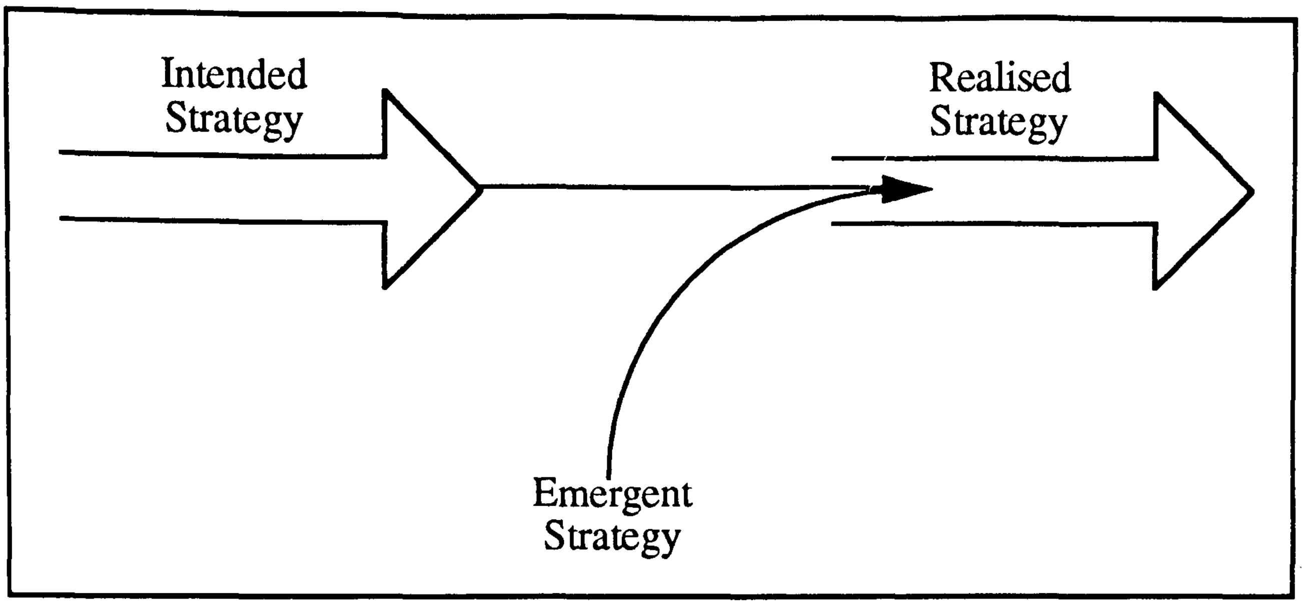
Hart (1992) suggests that under this paradigm the role of top management is to create a compelling long term vision which provides meaning for the organisation's activities and a sense of identity for its employees. A practical example of an ideological strategy is NEC's vision of "C&C" - the union of computers and communications. Through this NEC has been able to create a powerful metaphor which emphasises the importance of technological synergy within the firm (Prahalad and Hamel, 1989). Interestingly the ideological mode of strategy formulation correlates with Campbell and Tawadey's (1990) concept of mission.

Whichever of the above views one ascribes to - and there is increasing evidence to suggest that most strategies are a result of several interacting processes (Bailey and Johnson, 1992; Hart, 1992) - there is effectively universal, albeit sometimes implicit, agreement with Mintzberg's (1978) thesis that a strategy can only be said to exist, a posteriori, once a consistent pattern can be identified in the firm's decision and action streams (Hrebiniak and Joyce, 1984; Porter, 1980, 1985; Summer et al., 1990). Take, for example, the entrepreneurial mode of strategy formulation. If, as Hart (1992) suggests, the manager's role in this mode is to be a commander, then the strategy can only be realised if everyone consistently obeys his orders. Similarly the rationale underlying the ideological mode of strategy implementation is that a clearly defined vision will provide a framework which constrains, guides or induces consistency of decision making.

Perhaps the most difficult strategy process to relate to Mintzberg's (1978) thesis is the adaptive one. But imagine monitoring the path of an ant over a period of time. On the surface the ant's movements might appear random. As it encounters obstacles it will climb over them, change direction or even double back on itself. Over an extended period, however, it will become apparent that the ant's movements are directed toward some goal - that is, they are driven by an underlying consistency of purpose. So it is for managers who employ logical incrementalism. Their actions might appear random, but in reality they are consistently directed towards the realisation of a strategy (Mintzberg, 1973).

At a more practical level an example based on Porter's (1980, 1985) generic strategy of overall cost leadership can be used to illustrate the point that a strategy can only be realised through consistency decision making and action. Imagine a firm where the intended business strategy is overall cost leadership. If anyone makes a decision which is inconsistent with this strategy, the strategy may become diluted. Say, for example, the quality control manager decides to introduce stringent quality control procedures calling for 100% inspection. Product quality is likely to improve and manufacturing costs are likely to increase. Hence the firm's strategy will start to become one of differentiation - highish quality and lowish cost - rather than one of overall cost leadership, as was intended. This may not be an undesirable change in strategic direction. Indeed as figure 2.2 shows, strategies can emerge as a result of organisational learning or in response to changes in the external environment. For the purpose of this thesis, however, the key point is that unless there is some consistency of decision making and action, over an extended period of time, the firm will be unable to realise any strategy.

Figure 2.2: Intended, emergent and realised strategies (Mintzberg, 1978)



The above discussion raises an important question, namely if strategies can only be realised through consistency of decision making and action, then how can such consistency be induced within a firm? The business strategy literature identifies strategic controls as one means of doing this (Lorange, 1982; Hrebiniak and Joyce, 1984). According to Bungay and Goold (1991) a strategic control system normally involves the following:

-agreement of business objectives;

-monitoring of performance against these objectives;

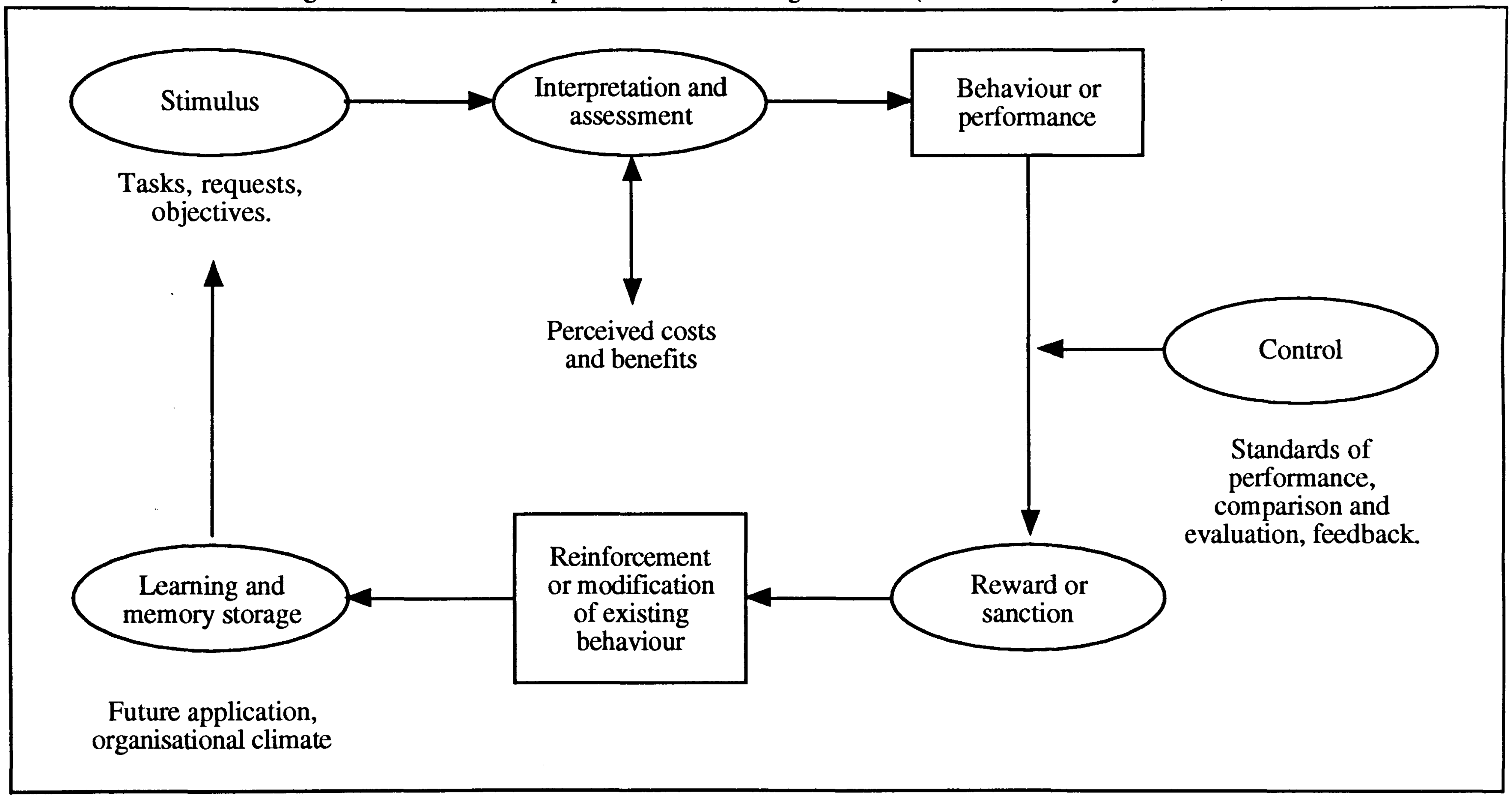
-feedback on results achieved;

-incentives and sanctions for business management.

Hrebiniak and Joyce (1984) use the stimulus-response model shown in figure 2.3 to argue that people are generally calculative. They suggest that as people weigh up the personal costs and benefits of any course of action before deciding what they will do, the strategic control system should be designed so that personal gain is maximised through successful implementation of strategy.

Goold and Quinn (1990) adopt a slightly broader definition. They see strategic controls as a means of monitoring the implementation of strategy as well as influencing it, and suggest that there are three reasons why a strategic control system should be established.

Figure 2.3: Stimulus-response model of strategic control (Hrebiniak and Joyce, 1984)



"First, a fundamental task for any large organisation is to coordinate the efforts of all those who work within it (Barnard, 1962)... Second, individual managers must be personally motivated to seek the goals that have been agreed. The provision of personal incentives and sanctions is important in creating this motivation (Slater, 1973)... Third, even the best-laid plans will sometimes fail. Senior management must then decide when and how to intervene, either by agreeing to altered goals, pressing for new plans or changing the responsible management. The control system prompts such action" (Goold and Quinn, 1990, 44).

Similarly Bungay and Goold (1991) see strategic controls as non-financial performance measures. They suggest that they can be used as a means of:

-clarifying what good performance is;

-making explicit the tradeoffs between profit and investment;

-introducing individual strategic stretch targets;

-ensuring that corporate management knows when to intervene because business performance is deteriorating.

Despite the academic interest in strategic controls there has been relatively little empirical research on their use (Goold and Quinn, 1990). Horovitz (1979) surveyed 52 European companies and found that although planning had evolved from a short to a long-term activity, control at the top management level still focused on monitoring short term operational performance rather than achievement of strategic plans. More recently Goold and Quinn (1988) surveyed 200 of the largest British companies and reported that only 11 per cent of them claimed to have a strategic control system. These findings can be contrasted with those of Daniel and Reitsperger (1991), who surveyed 26 Japanese automotive and consumer electronics firms and found that:

"Japanese firms have taken to heart the strategic management literature advocating strategic controls... Our findings indicate that modifications of management control systems by Japanese manufacturers are applied in Japanese plants as well as in operations abroad. These findings and the success of Japanese manufacturers in

> penetrating world markets support the normative theory that management control systems should be modified to fit strategy" (Daniel and Reitsperger, 1991, 616).

Based on the data he collected while working with 30 health care businesses, Simons (1991) has suggested that strategic control systems can be used either diagnostically or interactively. He argues that traditionally strategic controls have been seen as diagnostic management by exception tools. That is, managers are thought to use the control system as a feedback mechanism to ensure that they are informed when actual outcomes differ significantly from those planned. He reports that in practice, however, managers sometimes choose to have close personal involvement with a strategic control system. That is, they use the system interactively to ensure their subordinates focus on specific strategic uncertainties. Interestingly there is increasing evidence that Japanese firms use their management accounting systems in this way (Dugdale, 1990; Hiromoto, 1988; Morgan and Weerakoon, 1989).

> "High-level Japanese managers seem to worry less about whether an overhead allocation system reflects the precise demands each product makes on corporate resources than about how the system affects the cost-reduction priorities of middle managers and shop-floor workers" (Hiromoto, 1988, 22).

It should be noted, however, that the concept of using the management accounting system to induce behaviour consistent with the firm's goals is not particularly novel. Indeed as long ago as 1974 Hopwood suggested that managers should pay more attention to the behavioural implications of management accounting, while in 1972 Horngren argued that:

> "Above all, management accounting systems and techniques should encourage managers to act in harmony with the overall objectives of the organisation" (Horngren, 1972, 9).

2.2: **Organisational behaviour and culture**

Many of the concepts debated in the strategy literature can be traced back to work done by organisational behaviourists fifty years ago. Take, for example, coordination or consistency of purpose. As discussed earlier, Mintzberg (1978) has suggested that a strategy might best be described as a consistent pattern of decisions and actions. This notion appears to be synonymous with Barnard's (1938, 1948) view that an organisation only comes into being when:

> "(i) there are persons able to communicate with each other (ii) who are willing to contribute to action (iii) to accomplish a common purpose" (Pugh et al., 1988, 68).

Similarly, Fayol (1949) integrates the notions of strategy development and deployment when he defines the five core activities of management as:

(a) To forecast and plan - examining the future and drawing up the plan of action.

(b) To organise - building up the structure, material and human, of the undertaking.

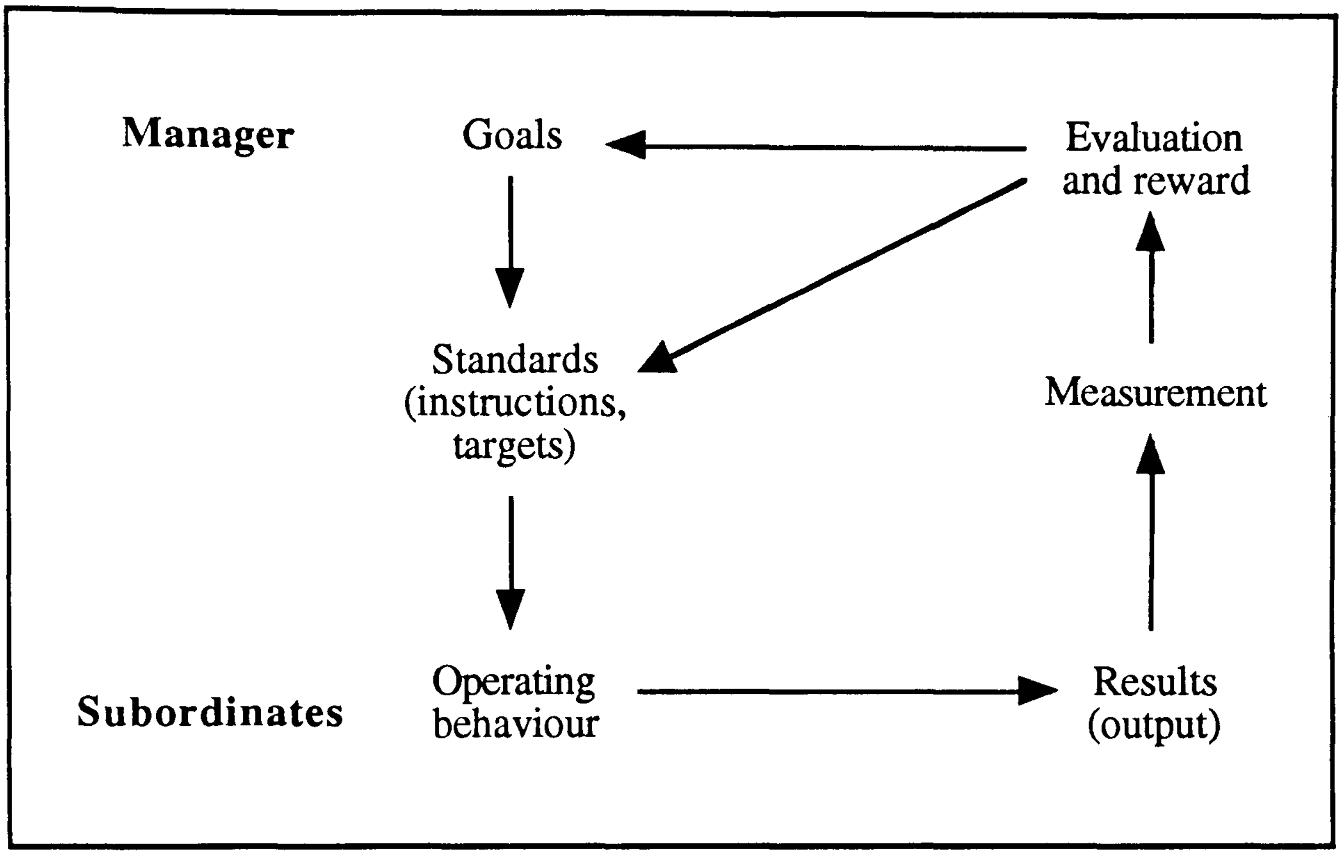
(c) To command - maintaining activity among the personnel.

(d) To coordinate - binding together, unifying and harmonising all activity and effort.

(e) To control - seeing that everything occurs in conformity with established rule and expressed command.

More recently parallels between the two fields can be observed in the arena of strategic or management control. Figure 2.4, for example, shows Child's (1985) model of the management control process. The similarities between this and Hrebiniak and Joyce's (1984) model of the strategic control process are striking.

Figure 2.4: The process of management control (Child, 1985)



Having recognised the fact that there is considerable synergy between the organisational behaviour and business strategy literature, it should be noted that the concepts discussed in the organisational behaviour literature are often richer. Authors such as, Bungay and Goold (1991), Daniel and Reitsperger (1991) and Simons (1991), for example, still use the same concepts as Lorange did in 1982 when discussing strategic control. Organisational behaviourists, on the other hand, appear to have explored management control more fully and:

-Have established that there are four different modes of management control. (See table 2.1).

-Argue that the appropriateness of the management control system is contingent on the organisation's size and age (Child, 1985)

-Question whether it is possible to develop the equitable performance measures that a management control system requires (Vroom and Deci, 1983).

-Take issue with the assumption that people are generally calculative (Etzioni, 1961, 1964; Weber, 1947).

Table 2.1: The four modes of management control (Child, 1985)

Personal Centralised Control
- Centralised decision making.
- Direct supervision.
- Personal leadership founded upon ownership or charisma, or technical expertise.
- Reward and punishment reinforce conformity to personal authority.

Bureaucratic Control
- Breaking down of tasks into easily definable elements.
- Formally specified methods, procedures and rules applied to the conduct of tasks.
- Budgetary and standard cost-variance accounting controls.
- Technology designed to limit variation in conduct of tasks, with respect to pace, sequence and possibly physical methods.
- Routine decision making delegated within prescribed limits.
- Reward and punishment systems reinforce conformity to procedures and rules.

Output Control
- Jobs and units designed to be responsible for complete outputs.
- Specification of output standards and targets.
- Use of "responsibility accounting" systems.
- Delegation of decisions on operational matters.
- Reward and punishment linked to attainment of output targets.

Cultural Control
- Development of strong identification with management goals.
- Semi-autonomous working.
- Strong emphasis on selection, training and development of personnel.
- Rewards orientated towards security of tenure and career progression.

Weber (1947), for example, argues that authority can be legitimised in organisations through three mechanisms - an individual's charisma, the organisation's history, or a rational-legal structure. Hence he would criticise Hrebiniak and Joyce's (1984) model of the strategic control process because it relies solely on a rational-legal mechanism.

> "The system is called rational because the means are expressly designed to achieve specific goals, i.e. the organisation is like a well-designed machine with a certain function to perform, and every part of the machine contributes to the attainment of maximum performance of that function. It is legal because authority is exercised by

means of a system of rules and procedures through the office which an individual occupies at a particular time" (Pugh et al., 1988, 17).

Similarly Etzioni (1961, 1964) contends that organisations rely on two types of compliance to ensure that their members behave in an appropriate manner.

> "Compliance in any organisation is two sided. On the one hand it consists of the control structures that are employed: the organisational power and authority structure which attempts to ensure that obedience is obtained. This Etzioni calls the structural aspect since it is concerned with the formal organisational system and the kind of power that the organisation uses to enforce compliance...
>
> The second aspect of compliance is based on the extent to which members of the organisation are committed to its aims and purposes. This is the motivational aspect and is expressed in the kind of involvement that the individual has with the organisation that he belongs to. The more intensely an individual is involved in the organisation the more likely he is to work towards the realisation of its goals" (Pugh et al., 1988, 74).

Hence Etzioni would criticise the traditional strategic control model because it is based on the assumption that the first of the above means of ensuring compliance, i.e. the formal system, is dominant in most organisations.

Interestingly in the organisational behaviour literature the concept of management control has recently been superseded by that of performance management (Erban, 1989; Fowler, 1990). According to Bevan and Thompson (1991) an organisation with a textbook performance management system should:

-Have a shared vision of its objectives, or a mission statement, which it communicates to all its employees.

-Set individual performance management targets which are related to both operating unit and wider organisational objectives.

-Conduct a regular, formal review of progress towards these targets.

-Use the review process to identify training, development and reward outcomes.

-Evaluate the effectiveness of the whole process and its contribution to overall organisational performance to allow changes and improvements to be made.

A performance management system, then, not only provides a means of enhancing an individual's commitment to an organisation, Etzioni's (1961, 1964) second method of ensuring of compliance, but also ties in with the concepts of an ideological strategy and a cultural control system, through the inclusion of a reference to the generation of a shared organisational vision.

The notion of a shared organisational vision is also discussed in the organisational culture literature. There it is argued that consistency of decision making and action will result if the organisation's values are widely shared by its members (Deal and Kennedy, 1982; Ouchi, 1981). Following their study of excellence in Japanese and American organisations Pascale and Athos (1981) employ a musical analogy to explain how this might work.

> "In management, as in music, there is a bass clef as well as a treble. The treble generally carries the melody in music, and the melody's equivalent is the manager's style. A manager's style - the way he focuses his attention and interacts with people - sets the tune for his subordinates and communicates at the operational level what his expectations are and how he wants business conducted. Beneath these messages is a deeper rhythm that communicates more fundamentally. The bass in music - whether hard rock or a classical symphony - often contains much of what moves the listener. So, too, the "bass" of management conveys meanings at a deeper level and communicates what management really cares about" (Pascale and Athos, 1981, 177).

In an unrelated study Peters (1978) argues that management can shape the glue which binds the organisation together, the superordinate goals or shared values, by paying careful attention to the mundane tools of management - symbols, patterns and settings. He suggests that as most employees watch what a firm's senior managers are doing, then if the Chief Executive consistently (a pattern) fills his calendar (a symbol) with meetings (a setting) to discuss quality then most of his employees will come round to the view that quality is of fundamental importance. Other organisational culturists, such as Deshpandé and Parasuraman (1986), Ouchi (1979) and Schwartz and Davis (1981), take this one stage further by exploring how corporate culture and strategy can be matched through the use of cultural audits and contingency models.

In summary, then, there appears to be widespread agreement with Mintzberg's (1978) thesis that strategies are realised through consistency of decision making and action (Faulkner and Johnson, 1992; Hayes, Wheelwright and Clark, 1988; Porter, 1980; Skinner, 1974b; Summer et al., 1990). In the business strategy literature it is usually argued that such consistency can be achieved through the use of strategic controls (Bungay and Goold, 1991; Goold and Quinn, 1990; Hrebiniak and Joyce, 1984; Lorange, 1982; Lorange et al., 1986). These are similar to the organisational behaviourist's centralised, bureaucratic or output based management control systems (Child, 1985). More recently, at least in the organisational behaviour literature, the concept of management control has been superseded by that of performance management (Bevan and Thomson, 1991; Erban, 1989; Fowler, 1990). A textbook performance management system, not only incorporates the main elements of a traditional strategic control system, but also introduces the notion of shared values or cultural control. A theme, which is pursued more fully in the organisational culture literature (Ouchi, 1981; Pascale and Athos, 1981). Hence there appear to be two fundamental ways of inducing consistency of decision making and action within organisations. The first is through the use of a formal control system, while the second relies on widely shared organisational values. These two mechanisms are neither mutually exclusive, nor all encompassing, as issues such as individual motivation and organisational history have a role to play (Child, 1985). They appear, however, to be the two primary means of inducing appropriate behaviour that are recognised in the business strategy, organisational behaviour and organisational culture literature. Hence let us now turn to the manufacturing strategy literature and examine the extent to which they have been considered by the Production and Operations Management (P/OM) community.

2.3: **Manufacturing strategy**

The manufacturing strategy literature lags behind that on business strategy (Anderson and Schroeder, 1991) and it was not until the early 1980s that the importance of manufacturing strategy became widely acknowledged (Chase, 1980; Miller et al., 1981). Indeed, of the 116 different books and papers on manufacturing strategy that Swamidass (1989) included in his selected bibliography, only 17 per cent of them were published prior to 1980. The earliest of these, "Manufacturing - Missing Link in Corporate Strategy" appeared in the Harvard Business Review in 1969. Skinner began that paper by saying: "a company's manufacturing function typically is either a competitive weapon or a corporate millstone" and so started a revolution in the strategic management of the manufacturing function (Skinner 1969, 136). The purpose of the next section is to examine that revolution by reviewing that literature which focuses on the content - the what - of manufacturing strategies. This will answer the first of the questions posed earlier, namely what is manufacturing strategy.

2.3.1: **The content literature**

In his seminal paper on manufacturing strategy Skinner (1969) suggested that many top executives fail to understand the full implications of the business strategy because they do not address the following questions:

> "If we are to compete with an X product of Y price for Z customers using certain distribution channels and forms of advertising, what will be demanded of manufacturing in terms of costs, deliveries, lead times, quality, and reliability?

Given the facts of the economics and the technology of the industry, how do we set ourselves up to meet the specific manufacturing tasks posed by our particular competitive strategy?" (Skinner, 1969, 144).

These questions define the two generic content variables - manufacturing task and policy decisions - which are now widely accepted as being the core of manufacturing strategy[1] (Leong et al., 1990). It appears that Skinner's (1969) aim was to provide an holistic framework within which these questions could be addressed.

During the early 1970s Skinner was largely responsible for the development of manufacturing strategy (Skinner, 1971, 1974a, 1974b, 1978). Initially he focused on the structural policy decisions, such as span of process, choice of process and equipment, plant location, determination of critical elements for control, while he paid little attention to the infrastructural issues, such as the control systems and management of the organisation (Skinner, 1969). Two years later, however, and following extensive field work he wrote:

> "In a nutshell, our methods of decision making, communicating, scheduling, and supervising make up the infrastructure of our plants; and these internal elements are proving more resistant to change than the purely technological ingredients on which factory managers and engineers tend to focus" (Skinner, 1971, 65).

It is interesting to note that this shift in emphasis which Skinner's early work exhibits, predates, but parallels one that can be observed in the field of Production/Operations Management as a whole (Neely, 1993a)[2] and is also, as this review will show, a trend which underlies the manufacturing strategy literature.

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1 For the purpose of this thesis manufacturing strategy is defined as the extended pattern of decisions and actions, both structural and infrastructural, which determine the capabilities of a manufacturing system and specify how it will operate in order to meet a set of manufacturing objectives which are consistent with the overall business objectives (Platts and Gregory, 1990, modified).

2 See Appendix I.

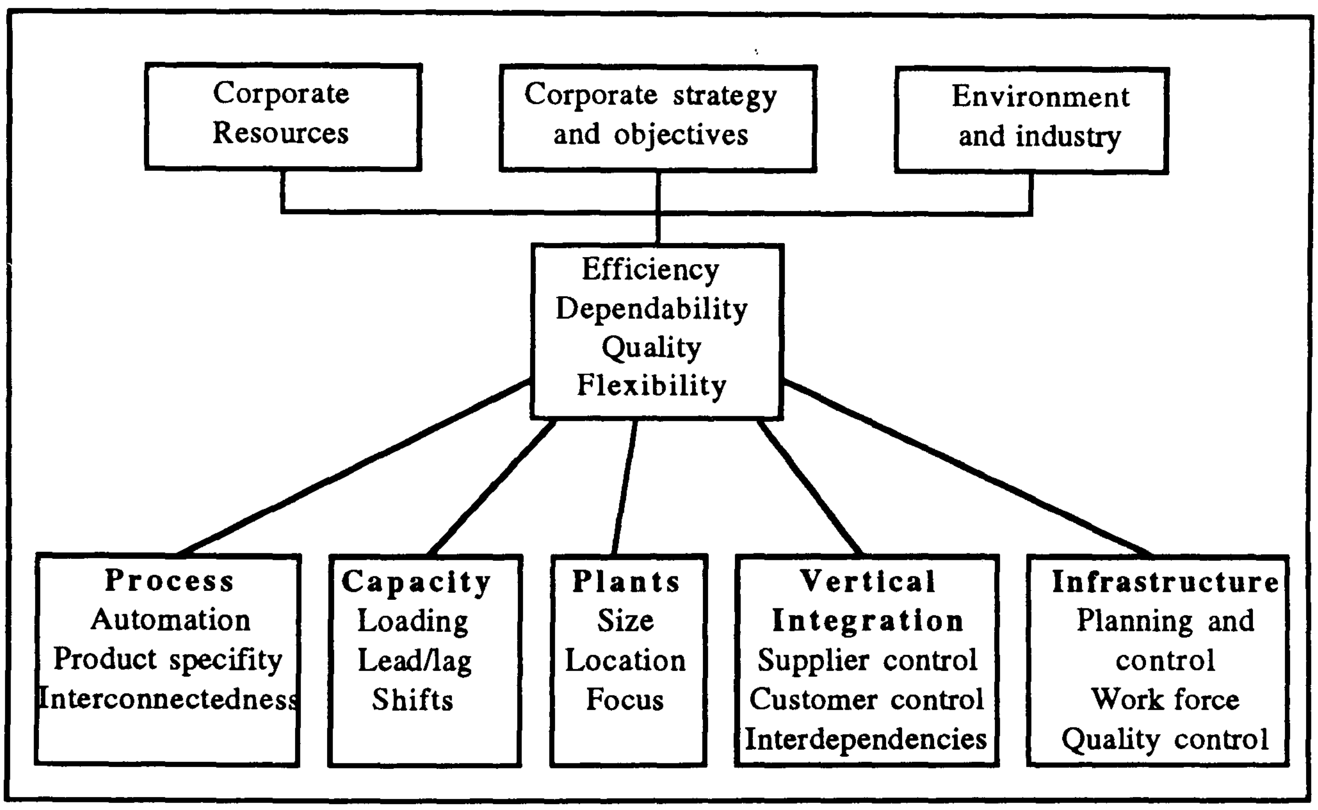
By the late 1970s the concept of manufacturing strategy was becoming increasingly popular. Skinner had already developed the concept of focus, arguing that the manufacturing function could best support the business strategy if its task was defined so that it only had to meet a limited and narrow set of objectives (Skinner, 1974a, 1974b). Hayes and Schmenner (1978) supported this thesis when they argued that the competitive priorities of the firm had to be defined before one could decide whether to focus the manufacturing function around products or processes. Others were examining issues such as the manufacturing marketing interface (Shapiro, 1977); the product process life cycle (Hayes and Wheelwright 1979a, 1979b); and the problems associated with strategic planning (Banks and Wheelwright, 1979; Hobbs and Heany, 1977; Wheelwright and Banks, 1979). Unfortunately all of these authors were focussing on single elements of manufacturing strategy, rather than trying to develop Skinner's holistic framework and perhaps this partly explains why it took so long for the importance of manufacturing strategy to become widely acknowledged (Chase, 1980; Miller et al., 1981).

Wheelwright (1978) was probably the first author who actually returned to Skinner's (1969) holistic view when he developed the conceptual framework shown in figure 2.5. This framework not only helped to operationalise Skinner's earlier work, but has also been used, either directly or indirectly, by Buffa (1984); Fine and Hax (1984, 1985); Haas (1987); Hayes and Wheelwright (1984); Hayes, Wheelwright and Clark (1988); Hill (1980, 1985, 1989); New (1979, 1992a, 1992b); Platts and Gregory (1990) and Samson (1991).

Wheelwright's (1978) paper is important for two reasons. Firstly he focuses primarily on the structural decision categories - process, capacity, plants and vertical integration. This bias toward the "harder" end of the spectrum remained throughout most of the 1980s (Hayes and Wheelwright, 1984). Indeed it was not until 1988 that it was finally laid to rest by Hayes, Wheelwright and Clark.

"Our earlier book [Hayes and Wheelwright, 1984] focussed most of its attention on manufacturing structural decisions [capacity, facilities, technology, vertical integration], but over the years we have become increasingly impressed by the importance of infrastructural elements [work force, quality, production planning and control, new product development processes, performance measurement and reward systems, organisational structure and design]. We have seen a number of companies that were able to build a powerful competitive advantage around their internal capabilities and teamwork, even though their plants and equipment were not exceptional; but we have never seen one that was able to build a sustainable competitive advantage around superior hardware alone. For this reason... it is almost impossible for a company to spend its way out of a competitive difficulty" (Hayes et al, 1988, 22).

Figure 2.5: Manufacturing strategy content (Wheelwright, 1978)



Second Wheelwright (1978) appears to have been the first to explicitly recognise that not only does each competitive priority have multiple dimensions, but also that it can be measured in a variety of ways.

"Efficiency - This criterion encompasses both cost efficiency and capital efficiency and can generally be measured by such factors as return on sales, inventory turnover and return on assets.

Dependability - The dependability of a company's products and its delivery and price promises is often extremely difficult to measure. Many companies measure it in terms of percent of on-time deliveries.

Quality - Product quality and reliability, service quality, speed of delivery, and maintenance quality are important aspects of this criterion. For many firms this is easy to measure by internal standards, but as with the other criteria, the key is how the market evaluates quality.

Flexibility - The two major aspects of flexibility changes are in the product and the volume. Special measures are required for this criterion, since it is not generally measured" (Wheelwright, 1978, 61).

More recently the whole question of competitive priorities and whether there really are tradeoffs between them has become the topic of debate (Skinner, 1992). The traditional view is that it is impossible for manufacturing to quickly make a wide range of high quality and low cost products (Skinner, 1969). One of the first to question this view was Wheelwright (1981) when he suggested that many Japanese managers seek ways to improve quality and reduce costs simultaneously. In 1986, using data collected during the manufacturing futures survey, Nakane hypothesised that Japanese managers attack the competitive priorities quality, time, cost and flexibility sequentially (DeMeyer et al., 1989). And in 1990 Schonberger suggested that:

"World-class strategies require chucking the [trade-off] notion. The right strategy has no optimum, only continual improvement - in all things" (Schonberger, 1990, 21).

The world class manufacturing view, however, is not universally accepted, especially by those who advocate a more traditional model of manufacturing strategy. New (1992a), for example, argues that while one can question whether certain tradeoffs exist, especially those relating to quality and cost, most of the evidence is anecdotal and drawn from the repetitive batch manufacturing industry. And Slack (1991) points out that there is a time dimension to the debate, for while it is usually impossible for a production manager to double a factory's output in twenty four hours without increasing cost, it may be possible for him to do so over an extended period of time. This point is important because it links manufacturing strategy to continuous improvement. Effectively Schonberger is suggesting that one has to improve continuously along all the competitive dimensions, whereas most manufacturing strategists would argue that, given limited resources, it is necessary to focus one's improvement activities (Neely, 1990).

There has been some debate as to how manufacturing actually contributes to the business. Hayes and Wheelwright (1984) suggest that there are four stages of evolution to manufacturing's strategic role. In stage 1 - internally neutral - the objective is to minimise the negative impact of the manufacturing function. Commonly, this involves using external experts to make decisions of strategic importance to manufacturing, using internal management control systems to monitor manufacturing performance and ensuring that manufacturing is kept flexible and reactive. In stage 2 - externally neutral - manufacturing's role is to help the business maintain parity with its competitors. Industry practice is followed, the planning horizon for manufacturing investment is extended so that it incorporates a single business cycle and capital investment is seen primarily as a way of catching up with the competition. In stage 3 - internally supportive - manufacturing exists to provide credible support to the business strategy. Manufacturing investments are screened for consistency with the business strategy, the implications of changes in business strategy for manufacturing are considered and a systematic approach to the long term development of the manufacturing function is adopted. In stage 4 - externally supportive - the business actually pursues a manufacturing based competitive advantage. Efforts are made to anticipate the potential of new manufacturing practices and technologies, manufacturing is involved in major marketing and engineering decisions and long range programmes are pursued in order to acquire capabilities in advance of needs. Traditionally writers on manufacturing strategy (Skinner, 1969; Hill, 1985) have adopted the view that the strategic role of the manufacturing function is best described as stage 3. Recently, however, with the growing interest in the learning organisation (Senge, 1992) and core competencies (Prahalad and Hamel, 1990), there has been increased emphasis on stage 4.

Alternative models of manufacturing strategy have also been suggested. Rhodes (1991), for example, presents a model of manufacturing strategy based on business processes, but makes no real attempt to operationalise it. Kotha and Orne (1989) introduce the concept of generic manufacturing strategies, following Porter's work (1980, 1985), and Sweeny (1991) suggests that such strategies may provide a way of managing the inherent complexity of developing manufacturing strategies. As with that on business processes, however, work on this topic is still at a very early stage and "it is still unclear whether generic manufacturing strategies do actually exist" (Sweeny, 1991, 6). Indeed empirical evidence is only now becoming available (DeMeyer, 1992; Sweeny, 1993).

Data on the use of manufacturing strategies in industry is limited (Anderson et al., 1989; Leong et al., 1990). The manufacturing futures survey has been used by Ward et al. (1988) to show that the main policy decisions identified in the literature match the strategic concerns of industry. And Tunälv (1992) has presented data supporting the hypothesis that business units with a manufacturing strategy are significantly more successful, in terms of their financial performance, than those without one.

In this section of the review the evolution of the manufacturing strategy literature has been described. It has been shown that there is widespread agreement within the academic community that a manufacturing strategy should consist of a series of statements describing **what** manufacturing is supposed to do - the competitive priorities - and **how** manufacturing is supposed to do it - the policy decisions. Table 2.2 summarises the development of manufacturing strategy since 1969. Note that it was not until 1989 that performance measurement, a central element in the strategic control process, was included in the framework. Traditionally manufacturing strategists appear to have focussed on issues such as where should plants be located and what should their capacity be (Hayes and Wheelwright, 1984). Only recently has it become widely accepted that a sustainable competitive advantage might result if consistency of purpose exists throughout the organisation (Hayes, Wheelwright and Clark, 1988).

2.3.2: **The process literature**

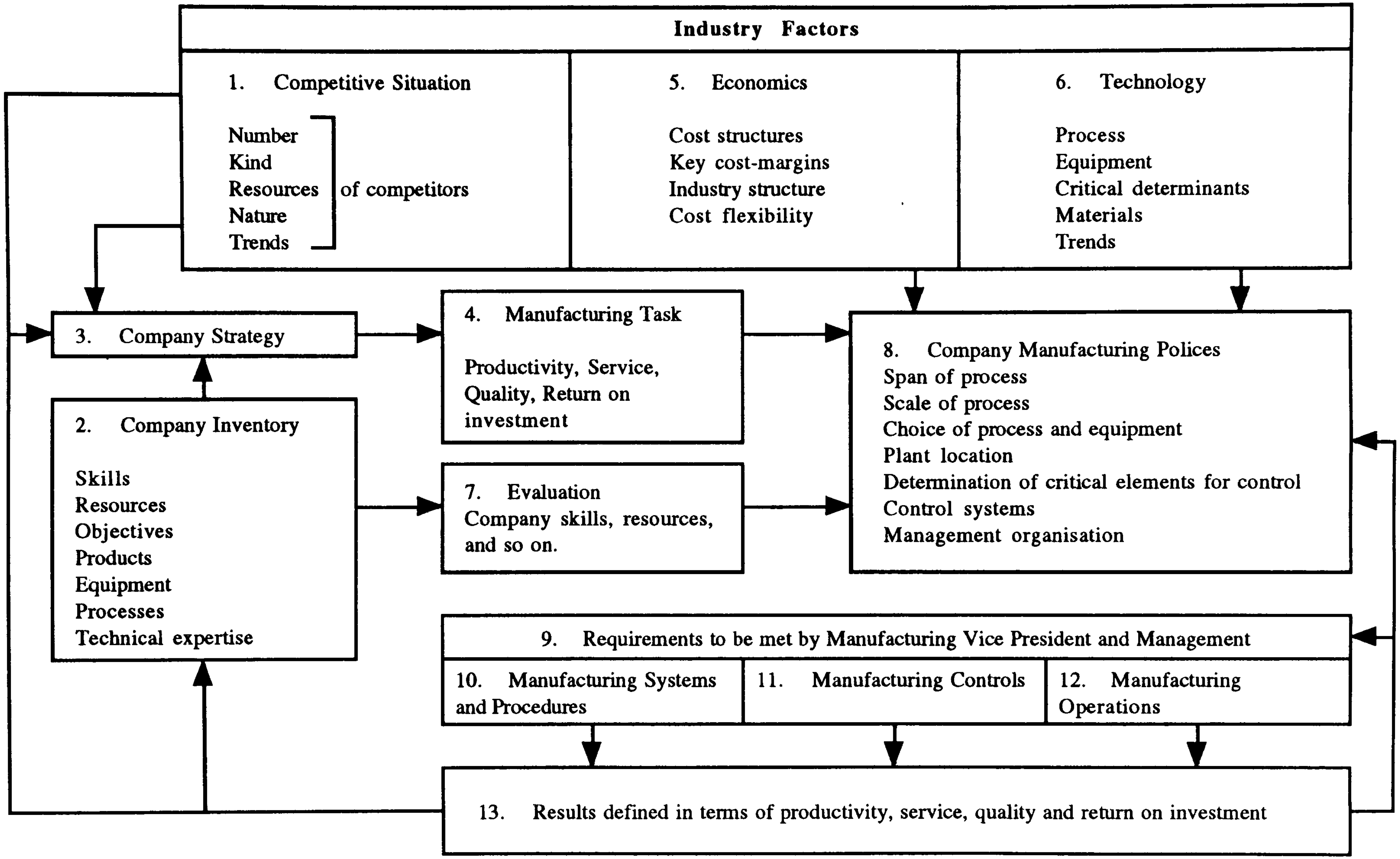
Most of the work on strategy formulation has been carried out by business strategists (Leong et al., 1990; Mintzberg and Quinn, 1992). Three generic approaches to developing manufacturing strategies, however, can be identified in the mainstream manufacturing strategy literature. The first, which can be described as top-down, was suggested by Skinner (1969) and is implicit in the work of Fine and Hax (1984), Hayes and Wheelwright (1984), Hayes, Wheelwright and Clark (1988), and Wheelwright (1978) but explicit in that of Platts and Gregory (1990). Skinner's (1969) approach, shown in figure 2.6, is, in many ways, similar to the one advocated by business strategists such as Ackoff (1970), Andrews (1971) and Ansoff (1986). He suggests that once a SWOT (strengths, weaknesses, opportunities, threats) analysis has been conducted and the business strategy defined, then the manufacturing task can be derived and the policy decisions made. To use Hayes and Wheelwright's (1984) terminology, then, Skinner (1969) sees manufacturing strategy as internally supportive. Hence he would argue that one of the key questions that needs to be addressed when developing a manufacturing strategy is; how does one ensure that the manufacturing task and policy decisions are consistent with the business strategy?

The top-down approach to manufacturing strategy development can be contrasted with Hayes' (1985) suggestion that the traditional strategic planning model of "ends-ways-means" may be fundamentally flawed. Hayes argues that

Table 2.2: The evolution of manufacturing strategy

<table>
<tr><th colspan="2"></th><th>Skinner (1969)</th><th>Wheelwright (1978)</th><th>Buffa (1984)</th><th>Hayes and Wheelwright (1984)</th><th>Hill (1985)</th><th>Hayes et al. (1989)</th></tr>
<tr><td colspan="2">Competitive Priorities</td><td>Productivity
Service
Quality
Return on investment</td><td>Efficiency
Dependability
Quality
Flexibility</td><td>Cost
Dependability
Quality
Flexibility
Service</td><td>Cost
Dependability
Quality
Flexibility</td><td>Price
Delivery Speed
Delivery Reliability
Quality
Flexibility</td><td>Cost
Dependability
Quality
Flexibility</td></tr>
<tr><td rowspan="2">Policy Decisions</td><td>Structural</td><td>Span of process
Scale of process
Choice of process and equipment
Plant location</td><td>Process
Capacity
Plants
Vertical integration</td><td>Product and process technology
Capacity
Facilities
Suppliers</td><td>Technology
Capacity
Facilities
Vertical integration</td><td>Process
Process positioning
Manufacturing systems
Work structuring</td><td>Technology
Capacity
Facilities
Vertical integration</td></tr>
<tr><td>Infrastructural</td><td>Determination of critical elements for control
Control systems
Management organisation</td><td>Infrastructure</td><td>Operating decisions
Work force and job design</td><td>Production planning
Organisation
Work force
Quality</td><td>Organisation structure
Function support</td><td>Production planning
Quality
Organisation
Work force
New product development
Performance measurement</td></tr>
</table>

Figure 2.6: The manufacturing strategy development process (Skinner, 1969)



the ends companies seek, that is their goals, are often short term, too easily copied and focus on quantitative issues, like return on investment, rather than the qualitative factors through which competitive advantage is usually gained. Furthermore, he points out that the ways, or strategies many firms adopt, place too much emphasis on goals and not enough on vision, and quotes William Bricker, chairman and CEO of Diamond Shamrock, who says;

> "Why has our vision been so narrowed? Why has our flexibility been constricted? To my mind there is one central reason: our strategies have become too rigid... A detailed strategy [is] like a road map... [telling] us every turn we must take to get to our goal... The entrepreneur, on the other hand, views strategic planning not as a road map but as a compass... and is always looking for the new road" (Hayes, 1985, 114).

Hayes continues by asking if the order of the terms ends, ways, means should be reversed. He suggests that firms could begin by developing their **means** - human and physical resources - and then find **ways** of exploiting matches between the firm's existing means and the market's requirements to achieve the ultimate **end**, which is a sustainable competitive advantage.

Such an approach is effectively a bottom-up process of strategy development and there are various examples of this having worked in practice. Pilkington Glass, for example, have been able to secure a sustainable competitive advantage through the development of the float-glass production process (Hill, 1985). All of Pilkington's competitors have to pay royalties if they wish to use this process and so, through the entrepreneurial development of its own technological means, Pilkington has attained a sustainable cost advantage.

The bottom-up approach to strategy formulation, also links in with the concepts of core competence (Cleveland et al., 1989; Prahalad and Hamel, 1990; Vickery, 1991), core capabilities (Stalk et al., 1992) and the learning organisation (Leonard-Barton, 1992; Senge, 1992). One of Pilkington's core competencies is the float-glass production process. One of Toyota's, on the other hand, is the Toyota Production System, which itself has been developed through a process of continuous learning and improvement (Womack et al., 1990). If one were to adopt this view of strategy formulation, then, one of the key questions that would have to be addressed is; how does one ensure that the resources devoted to the development of new "means" (core competencies, core capabilities, etc.) are not wasted?

The third generic process that can be used to develop a manufacturing strategy can best be described as iterative and is the one that is implicit in Hill's (1980, 1985) model. He advocates the five step approach to the development of the corporate, marketing, business and manufacturing strategies, shown in figure 2.7 and argues that manufacturing managers have traditionally only been involved in the last two stages - process choice and the development of the manufacturing infrastructure. Hill (1980) believes this is partly because they view themselves as being primarily responsible for fine tuning the manufacturing system so that it can respond to the requirements of the business and also because they lack the language to explain the strategic implications of their function. He points out that this reactive mode of strategy development paradoxically means that the manufacturing function has little influence on the choice of how a firm decides to compete in the market place (the business strategy) even though it has a major impact on whether the chosen competitive criteria can be met. He therefore argues that the loop shown in figure 2.7 represents the true iterative nature of how the strategy development process should be conducted and suggests that not only must manufacturing try and do what is required, but also that the corporate, marketing and business strategies should be defined in a way that acknowledges the inherent strengths and weaknesses of the manufacturing function.

The three approaches described above are all academic models of the manufacturing strategy development process. Little empirical data which describes the processes actually used by industry is available (Anderson et al., 1989; Leong et al., 1990) and that which exists usually comes in the form of case studies (Hill, 1989; Samson, 1991). Voss (1992), for example, interviewed executives from four U.K. companies, all of whom had been involved in the development of manufacturing strategies. The data he collected showed that the manufacturing strategy formulation process normally consists of the four stages shown in figure 2.8.

Figure 2.7: Hill's model of manufacturing strategy (Hill, 1985)

Step 1	Step 2	Step 3	Step 4	Step 5
Corporate Objectives	Marketing Strategy	How do products win orders?	Manufacturing Strategy	
			Process choice	Infrastructure
growth profit ROI other "financial" measures	product markets and segments range mix volumes standardisation or customisation innovation leader or follower	price quality delivery speed delivery reliability colour range product range design leadership	processes tradeoffs embodied in process choice role of inventory	functional support manufacturing systems and control work structuring organisational structure

In an attempt to operationalise some of the manufacturing strategy concepts the U.K. Department of Trade and Industry commissioned a workbook entitled Competitive Manufacturing which is described as "a practical approach to the development of a manufacturing strategy" (DTI, 1988). This book is a useful tool because it provides a series of check sheets which enable a group of managers to define their firm's competitive priorities and assess whether their manufacturing policies are appropriate. But even the authors admit that it is merely the first step in the process of developing a manufacturing strategy.

There is slightly more literature on realising strategies than there is on their development, perhaps because the relevant data can be collected through both surveys (Swamidass, 1986; Schroeder et al., 1986; Anderson et al., 1991) and case studies (Booth, 1990; Hill, 1989; New, 1992a; Samson, 1991).

Figure 2.8: The four stages of strategy formulation (Voss, 1992)

Set up	Trigger Leadership Scope
Process	Functions involved Process leadership Facilitator Pattern
Analysis 1	Outside-in Corporate objectives Marketing analysis Inside-out Manufacturing capability Manufacturing performance Competitor analysis
	Manufacturing task/mission
Analysis 2	Specify ideal plant Programmes of action Investment plans
	Present to board Implementation

In 1986 Swamidass surveyed 35 U.S. firms and found that:

-The term manufacturing strategy is not well understood in industry.

-There is a mismatch between executives' perception of the strengths of manufacturing and its strategic role.

-There is a mismatch between the manufacturing priorities of the Chief Executive and the Manufacturing Managers.

-Manufacturing strategy is neither visible nor obvious in most firms.

In a separate study Schroeder et al. (1986) surveyed 39 manufacturing managers who were attending a course at the University of Minnesota and found that:

-Only one third of the managers present claimed that their firms had clear and consistent manufacturing strategies.

-The terminology surrounding the subject was seen to be confusing.

-Manufacturing strategies tend to be derived from business strategies. That is, the strategic role of manufacturing is best described as stage 3 using Hayes and Wheelwright's (1984) terms.

Anderson et al. (1991) repeated this exercise a few years later when they surveyed 53 manufacturing executives who were attending executive programmes at the University of Minnesota. This time their survey focussed on the process of developing both manufacturing and business strategies and found that:

-Manufacturing executives are often asked to help with the development of a business strategy late in the cycle.

-Manufacturing strategies are not as well documented or communicated as business strategies.

Unfortunately - from a research perspective - case studies such as those presented by Hill (1989) and Samson (1991) tend to be success stories and hence it is difficult to glean specific information from them regarding the barriers to manufacturing strategy realisation. One study which departs from this format, however, is described by Marucheck et al. (1990). They invited executives from six companies to discuss manufacturing strategy formulation and implementation at an open meeting and report that:

-All the firms used a traditional top down process of strategy formulation.

-In general the processes they used were reactive to both the corporate and marketing strategies.

-Several of the policy decision categories were constrained by the corporate philosophy.

-The implementation process was seen as one of gaining employee acceptance.

-The most difficult task in implementation was changing the corporate culture especially when it was embedded in an obsolete cost accounting system.

-Other areas of difficulty included maintaining consistency across all levels of management in the organisation, gaining top management support and developing appropriate styles of leadership.

In this section the paucity of literature on the process of developing and realising manufacturing strategies has been discussed. Leong et al. (1990) argue that progress in the field has been limited by the lack of empirical data and the failure of manufacturing strategists to import ideas from related disciplines, especially business strategy. One such idea is the notion that strategies can only be realised through consistency of decision making and action. This concept is implicitly accepted by many manufacturing strategists (Hayes and Wheelwright, 1984; Hill, 1985; Platts and Gregory, 1990; Skinner, 1971), but its implications are rarely discussed. Marucheck et al. (1990), for example, identify changing a corporate culture embedded in an obsolete cost accounting system and maintaining consistency across all levels of management, as two major barriers to the realisation of manufacturing strategy, but fail to acknowledge that shared organisational values or the use of appropriate strategic controls may overcome these problems. It appears that while the concepts of goal and system congruence are implicitly accepted by many authors (Hayes, Wheelwright and Clark, 1988; Hill, 1985; Skinner, 1971), manufacturing strategists on the whole have failed to explore whether they can be used in an operational setting. Having said this a number of uni-dimensional studies of both goal and system congruence have been reported. These are reviewed in the next section.

2.4: **Relevant studies:**

In this section those studies of goal and system congruence that have been identified as being directly relevant to the work reported in this thesis will be reviewed. In order to simplify this process, the research into goal congruence will be reviewed separately to that into system congruence.

2.4.1: **Goal congruence:**

Grinyer and Norburn (1977-78) report a study of 21 firms in which they sought evidence of a general causal relationship between corporate planning and performance. They restricted the scope of their investigation by focusing solely on the strategic issues of market penetration and product range. Data were collected during 91 structured interviews. Consensus, or congruence, was measured by calculating the percentage of interviewees within a firm who gave the same answer to a specific question. Performance was related to return on net assets. During each interview Grinyer and Norburn asked the interviewee to specify existing corporate objectives and to identify those that they thought desirable. Having analysed the data they rejected their hypothesis that financial performance is positively correlated with widely shared corporate objectives. In fact they found "that for 'ideal' objectives (but not for actual ones), there may be a slight negative correlation" (Grinyer and Norburn, 1978, 107). These findings were supported by DeWoot et al. (1977-78) following their study of 168 Belgian firms.

In 1980 Bourgeois studied top management agreement on both corporate objectives (goals) and competitive weapons (means). First he interviewed the chief executive officers of 12 non-diversified public corporations and asked them to specify which members of their staff were most closely involved with the strategy development process. Then he surveyed the 71 managers identified and asked them to rate the importance of 12 corporate goals and 23 competitive weapons, on a five point scale.

Bourgeois hypothesised that:

-Agreement on ends (corporate objectives) and means (competitive weapons) would lead to the highest levels of performance.

-Agreement on ends but not on means would lead to the second highest levels of performance.

-Agreement on means but not on ends would lead to the third highest levels of performance.

-Agreement on neither ends nor means would lead to the lowest levels of performance.

Figure 2.9: Matrix showing Bourgeois' (1980) hypotheses

	Agreement on ends	No agreement on ends
Agreement on means	Will lead to the highest level of performance	Will lead to the third highest level of performance
No agreement on means	Will lead to the second highest level of performance	Will lead to the lowest level of performance

He calculated the level of dissonance, or incongruence, by summing the standard deviations of the respondent's ratings and defined firm performance as a composite of return on invested capital (total assets), growth in capital, growth in net earnings, growth in earnings per share, and five year averaged growth in profit margin. 69 of the 71 questionnaires were returned and having analysed the data Bourgeois said:

> "the only secure conclusion that can be drawn... is that consensus on means always yields higher performance than disagreement on means, while allowing disagreement on less tangible goals tends to be associated with better performance. Also, the worst performance results in goals agreement combined with means disagreement - i.e., when a firm agrees on where it wants to go but it can't agree on how to get there! This suggests a 'paralysis of action' condition in which consensus of purpose is not sufficient for the law of equifinality to take hold if the firm's subunits wish to allocate resources to too many diverse competitive weapons for concerted action to

prevail. That is, disagreement on the choice of competitive weapons may hurt because the domain navigation strategies of the different functional areas clash, causing muddled and internally inconsistent or incomplete strategies" (Bourgeois, 1980, 243-244).

Bourgeois defines "ends" as profit, growth rate and market share, whereas he categorises cost reduction, employee efficiency and product quality as "means". These categorisations are important because Bourgeois' means equate to a manufacturing strategist's competitive priorities and hence Bourgeois' findings suggest that agreement on competitive priorities should lead to higher levels of organisational performance.

Hrebiniak and Snow (1982) examined the relationship between top-management agreement on an organisation's strengths and weaknesses and firm performance. To do so they collected survey data from 247 executives in 49 different companies. In their questionnaire each respondent was asked to rate various organisational functions (general management, financial management, marketing/selling, production, etc.) as strong, average or weak. Managerial agreement was calculated as a function of the standard deviation of the responses and organisational performance as a ratio of total operating income to total assets. Having analysed the data, Hrebiniak and Snow (1982, 1153) found that "agreement among top executives on an organisation's strengths and weaknesses is related to organisational performance". They argue that this result shows how important it is for top management to work together to define the firm's strengths and weaknesses during the strategic planning process.

Dess (1987) reports a study of the relationship between organisational performance and top management agreement on company objectives and competitive methods in the paint and allied products industry. He argues that because of the intense competitive pressures in this industry "a high level of consensus in strategy-making is... critical in promoting a unified direction for the firm and enhancing the successful implementation of a given strategy"

(Dess, 1987, 260). Having received 74 usable responses (80%) from his survey of 19 firms Dess found that consensus on either company objectives or competitive weapons was positively correlated with a firm's performance. After acknowledging that this finding contradicts Bourgeois' earlier study, Dess points out that the studies are not necessarily comparable as they use different performance indicators.

St. John and Rue (1991) explored the relationship between the coordinating mechanisms used by firms (formal forecasting procedures, management by objectives linked to performance appraisal, and a written strategic plan), the degree of consensus between marketing and manufacturing, and market place performance reputation. They collected their data by surveying 168 vice-presidents, sales managers, and plant managers within 15 companies in the U.S. carpet industry and found that consensus between departments was strongly related to market place performance reputation.

Other authors have examined consensus in organisations, but made no attempt to link it to performance (Lawrence and Lorsch, 1967; Stagner, 1969). Hambrick (1981), who investigated the extent of strategic awareness in top management teams, argues that strategic awareness can be viewed in two complementary ways:

> "(1) the degree of agreement between an executive's perception of the organisation's strategy and its realised strategy (as externally measured), and
>
> (2) the degree of agreement between an executive's perception and the chief executive's perception of the organisation's strategy" (Hambrick, 1981, 263).

In his study he examined 20 service organisations - either private liberal arts colleges, voluntary general hospitals, or life insurance firms - and found that often strategic awareness did not even exist at the highest levels of the organisation.

In the more specialist manufacturing arena there are few practical studies of goal congruence. Wheelwright (1978) presents a case study in which the vice-president of manufacturing asked his managers to prioritise the cost, quality, dependability and flexibility elements of the firm's manufacturing strategy. He concludes that the discussion this provoked led to a better understanding of the strategy within the manufacturing function. Both New (1992b) and Platts and Gregory (1990) suggest that a similar technique - competitive profiling - can be used at the start of the manufacturing strategy formulation process to generate management commitment.

Richardson et al. (1985) conducted a more formal investigation of goal congruence when they examined the relationship between profit, the chief executive's goals and his perception of the manufacturing task. In their study of 64 Canadian electronics manufacturers they asked each chief executive to answer a series of questions and from these defined both the corporate mission and the manufacturing task. They then, somewhat subjectively, defined whether the two were congruent, or mutually supportive, and hypothesised that performance - defined as profit plus research and development expenses (after tax) as a percentage of sales - would be positively correlated with the level of congruence. Having analysed the data, Richardson et al. concluded that:

> "performance was positively related to increasing focus [of corporate mission], and although congruence between corporate mission and manufacturing task appeared less important, the relationship was still significant" (Richardson et al., 1985, 25).

In 1986 Swamidass studied the manufacturing strategies of 35 firms from the Pacific Northwest through a series of questionnaires and interviews. In each firm he gathered data from both chief executive officers, or their equivalent, and manufacturing managers and was hence able to compare their different views of manufacturing strategy. He found that:

> "while chief executives stressed quality, technology, etc., which would contribute to

a business level strategy based on product differentiation, manufacturing managers stressed cost, and the keeping of delivery promises" (Swamidass, 1986, 471).

Swamidass also conducted a separate, but related study, with Newell in which they used a path analytic model to examine manufacturing strategy, environmental uncertainty and performance (Swamidass and Newell, 1987). Based on the same data used in the study discussed above they found that flexibility was positively correlated with performance; that the more manufacturing managers were involved in strategic decision making the higher the levels of performance; and that increased flexibility and higher levels of involvement by manufacturing managers helps firms overcome the problems of environmental uncertainty.

Lindman and Callarman (1990) examined the link between manufacturing strategic consensus and manufacturing operational performance. Although they only present their preliminary results and provide no information on their methodology, their conclusions are interesting because they find that there is a "statistically significant positive association between SBU [strategic business unit] manufacturing consensus and manufacturing operational performance" (Lindman and Callarman, 1990, 397).

Hailey et al. (1991) report a study of the goal orientation of production and quality control managers. They sent a copy of England's (1967) Personal Values Questionnaire to 237 production and quality control managers[3] and asked them what they thought the goals of their businesses were. Based on a 32 per cent response rate Hailey et al. report a significant difference between the goal orientations of the managers surveyed:

"Production managers perceive profit maximisation and high productivity as most important (e.g. pushing the product through the organisation). Quality control managers perceive organisational efficiency and high productivity as most important

3 All the managers surveyed were members of either the American Society for Quality Control or the American Production and Inventory Control Society.

(e.g. producing products of sufficient quality)" (Hailey et al., 1991, 47).

When discussing these findings Hailey et al. suggest that these differences may be a result of the managers adopting a functional perspective consistent with their responsibilities. In terms of the work reported in this thesis, then, Hailey et al's study serves as a reminder that the level of goal congruence observed in a firm might be affected by the organisation's structure.

In this section various studies of goal congruence documented in both the business and manufacturing strategy literature have been reviewed. It can be seen that most of the work on goal congruence carried out to date has focused on the top management team. Indeed the author has been unable to find any studies which explore whether the concept of goal congruence can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy. The closest is perhaps the work on surfacing managerial assumptions (Bowman and Johnson, 1992; Checkland, 1981; Checkland and Scholes, 1990; Eden, 1992; Eden et al., 1979; Eden and Radford, 1990; Mason and Mitroff, 1981; Slack, 1991, 1993). Bowman and Johnson (1992), for example, have developed a questionnaire, based on Porter's generic strategies, which is designed to explore managerial preconceptions about business strategy. Similarly the methodologies developed for soft systems analysis (Checkland, 1981), strategic options development and analysis (Eden et al., 1979) and strategic assumptions surface and testing (Mason and Mitroff, 1981) can be used to help surface managerial assumptions, especially if the strategy formulation is viewed as a social process (Eden, 1992). In the more specialised manufacturing and operations arena Slack (1991, 1993) argues that the importance-performance matrix can be used to highlight, among other things, a lack of goal congruence in the early stages of strategy development.

Most of these techniques, however, are designed to be used with the top management team during the business strategy formulation process and are rarely discussed in the manufacturing strategy literature. As a consequence they do not appear to have been applied to the manufacturing strategy implementation process and this is unfortunate because as Bailey and Johnson (1992) point out:

> "The influence of top level decision-makers decreases as a strategy enters the implementation stage, while the influence of lower level managers increases" (Bailey and Johnson, 1992, 156).

2.4.2: **System congruence:**

Research on system congruence appears to be more sparse than that on goal congruence and most that has been undertaken tends to focus on a single system, e.g. performance measurement or reward, rather than adopting an holistic perspective (Neely, 1993b).

Greer and Hawkins (1976) studied sales force compensation and argued that unit based commission plans can lead to salesmen maximising their own income at the expense of the firm. Shapiro (1977) discussed the conflict between marketing and manufacturing and suggested that it is partly a result of the evaluation and reward systems used by many firms.

> "One prime reason for the marketing/manufacturing conflict is that the two functions are evaluated on the basis of different criteria and receive rewards for different activities. On the one hand, the marketing people are judged on the basis of profitable growth of the company in terms of sales, market share, and new markets entered. Unfortunately, the marketers are sometimes more sales-oriented than profit-oriented. On the other hand, the manufacturing people are often evaluated on running a smooth operation at minimum cost. Similarly unfortunately, they are sometimes more cost-oriented than profit-oriented.
>
> The system of evaluation and reward means that the marketers are encouraged to generate change, which is one hallmark of the competitive marketplace. To be rewarded, they must generate new products, enter new markets, and develop new

> programmes. But the manufacturing people are clearly rewarded for accepting change only when it significantly lowers their costs.
>
> Because the marketers and manufacturers both want to be evaluated positively and rewarded well, each function responds as the system asks it to in order to protect its self-interest" (Shapiro, 1977, 108).

This thesis, however, is more concerned with dysfunctionality in the manufacturing function induced through the traditional elements of the strategic control system, namely the goal setting, performance measurement, feedback and reward systems. Fry and Cox (1989) argue that the main problem is local performance measurement. They cite the case of a company where the plant manager was primarily concerned with return on investment, the product group managers were evaluated according to the number of orders that were shipped on time, and the supervisors and operatives were measured according to standard hours produced. Fry and Cox point out that these measures encourage the supervisors and operatives to save set-up time by producing batches larger than those scheduled. Hence some orders were delayed and the product group managers had to sanction overtime to ensure good due-date performance, which, in turn, had a negative impact on the plant's managers performance measure - return on investment.

In one of the more academic studies of performance measurement Richardson and Gordon (1980) hypothesised that:

-As products move through their life cycle the appropriate performance measures will change.

-Performance measures will be easier to develop for products late in their life cycle as these tend to compete on cost rather than innovativeness.

-Dysfunctional consequences will result if measures are not appropriate.

-In multi-product facilities "traditional" measures will inhibit innovation.

-Manufacturing managers will respond to their perceived measures of performance.

Having collected data during interviews with the chief executive and manufacturing managers of 15 Canadian electronics companies they observed that:

-The performance measures used did not change as products moved through their life cycle.

-The measures did not become better defined later in the product's life cycle, primarily because the performance measures used tended to focus on the plant as a whole, rather than individual products.

-Inappropriate measures did introduce dsyfunctionality.

-Traditional measures did inhibit innovation.

-Managers did respond to their perceived measures of performance.

Richardson and Gordon's study is typical of most of the work on system congruence that has been reported in the manufacturing management literature in that it focuses solely on the performance measurement system. Woodcock (1991), adopted a similar perspective when he examined whether manufacturing managers received the strategic data they needed to determine if their function was in "control", as did Wisner and Fawcett (1991) when they argued that strategy could be linked to operating performance through performance measurement.

In general, the theme that pervades the literature is that pure financial measures of performance are inappropriate for manufacturing (Johnson and Kaplan, 1987; Maskell, 1991). Kaplan and Norton (1992) use the analogy of an aeroplane cockpit, arguing that executives need to be able to assimilate a lot of information at a glance if they are to manage their business effectively. And following their research with twelve leading U.S. companies, they suggest that a truly "balanced scorecard" would include information on:

-how customers see the firm (the customer perspective);

-what the firm must excel at (the internal perspective);

-how the firm can continue to improve and create value (the innovation and learning perspective);

-how the shareholders see the firm (the financial perspective).

In this section various studies of system congruence have been reviewed and it is apparent that research on the topic is relatively rare. At a broader level this chapter has shown that the production/operations management community has, on the whole, failed to explore whether the notions of goal and system congruence introduced by organisational culturists, organisational behaviourists and business strategists, can be operationalised and used to identify some of the reasons why a firm might be unable to realise its manufacturing strategy. Indeed the author has only been able to identify one study - that reported by Dixon, Nanni and Vollmann (1990) - in which this has even been partially attempted. They have developed and tested a Performance Measurement Questionnaire (PMQ) which they say can be used by managers to assess the status of their measurement systems. The PMQ consists of three stages. In the first, general data on both the company and respondent is collected. In the second the respondent is asked to identify those areas of improvement that are of long term importance to the firm and to say whether the current performance measurement system inhibits or supports such activity. While in the third the respondent is asked to compare and contrast what is currently most important for the firm with the measurement system emphasises.

Once the data has been collected Dixon, Nanni and Vollmann suggest that four types of analysis should be carried out. The first is alignment analysis in which the extent of match between the firm's strategies, actions and measures is assessed. The second is congruence analysis which provides more detail on the extent to which the strategies, actions and measures are mutually supportive. The third is consensus analysis, where the data is analysed according to management position or function. And the fourth is confusion analysis where the range of responses, and hence the level of disagreement, is examined.

The PMQ, then, can be used to assess the level of both goal and system (performance measurement) congruence in an organisation. Dixon, Nanni and

Vollmann's view of strategy, however, is somewhat unconventional in that they list about thirty performance areas, including inventory turnover, cost of quality, vendor quality, etc. but make no formal attempt to link these to a firm's manufacturing strategy. Furthermore, they focus exclusively on the performance measurement system and do not consider the way in which goals are set, feedback is provided, or performance rewarded.

In summary, then, while there is widespread recognition within the manufacturing strategy literature that high levels of goal and system congruence may lead to consistency of decision making and action, and hence realisation of strategies, the author has been unable to identify any systematic studies which have explored the validity and potential of these academic constructs. The purpose of the work reported in this thesis is to fill this gap in the academic body of knowledge through:

- The development of a process for auditing the levels of goal and system congruence.
- The testing of this process to discover whether it can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy.

In the next chapter the research will be explored more fully as the author's methodology is documented.

CHAPTER 3: RESEARCH FRAMEWORK

CHAPTER 3: RESEARCH FRAMEWORK

3.0: Introduction

Already in this thesis a number of themes have been raised. Briefly these can be summarised as follows:

(a) Manufacturing strategy is now widely accepted as being important (Chase, 1980; Miller et al., 1981; Swamidass, 1989).

(b) The Production and Operations Management (P/OM) community has broadly been able to agree on the appropriate content for a manufacturing strategy, but has failed to reach any consensus on the processes that should be used to develop and implement one (Anderson and Schroeder, 1991; Leong et al., 1990).

(c) A strategy can only be implemented, or realised, through consistency of decision making and action (Faulkner and Johnson, 1992; Hayes, Wheelwright and Clark, 1988; Hrebiniak and Joyce, 1984; Mintzberg, 1978; Porter, 1980, 1985; Prahalad and Hamel, 1989; Skinner, 1974b).

(d) Consistency of decision making and action can be induced through values that are widely shared (Child, 1985; Deal and Kennedy, 1982; Ouchi, 1981; Pascale and Athos, 1981).

(e) Consistency of decision making and action can also be induced through the use of appropriate goal setting, performance measurement, feedback and reward systems (Bevan and Thomson, 1992; Bungay and Goold, 1991; Child, 1985; Erban, 1989; Fowler, 1990; Goold and Quinn, 1990; Hrebiniak and Joyce, 1984; Lorange, 1982; Lorange et al., 1986; Simons, 1991).

(f) Although the validity of the two previous concepts has been implicitly recognised by many manufacturing strategists, the author has been unable to find any studies which have explored whether the notions of goal and system congruence can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy.

The purpose of this chapter is to integrate these themes thereby providing a coherent justification for the work reported in this thesis. Following this the author's research methodology will be explained. The remainder of the chapter has been divided into four sections. In the first the conceptual framework which underpins the research is presented. In the second the gap in the academic body of knowledge that the author sought to fill through this study is identified. In the third the research methodology is described. In the fourth a brief summary of the chapter is provided.

3.1: **Conceptual framework**

As stated in chapter 1 the key assumptions underlying this research are that consistency of decision making and action, and hence realisation of strategies, might best be achieved if:

(a) **There is widespread empathy within the firm with the organisation's strategic goals (goal congruence).**

(b) **The organisation's signalling systems - especially those concerned with goal setting, performance measurement, feedback and reward - induce decision making and action which is consistent with the organisation's strategic goals (system congruence).**

For the manufacturing function, the organisation's strategic goals are defined by the first[4] of Skinner's (1969) two dimensions of manufacturing strategy - the manufacturing task. This addresses the following question; what must the manufacturing function do if it is to support the business strategy?

As discussed in chapter 2 it is now widely accepted that the manufacturing task can be defined in terms of quality, delivery speed, delivery reliability, price (cost), and flexibility (Leong et al., 1990). Manufacturing and business strategists argue that a firm will only be able to realise its manufacturing strategy if the decisions and actions taken within the manufacturing function are consistent, or congruent, with the manufacturing task (Hayes, Wheelwright and Clark, 1988; Mintzberg, 1978; Skinner, 1974b). Organisational culturists and organisational behaviourists suggest that such consistency should result if the appropriate values are widely shared (Child, 1985; Deal and Kennedy, 1982; Ouchi, 1981; Pascale and Athos, 1981). Hence for the purpose of this thesis a high level of goal congruence is said to exist if:

-The manufacturing task, defined in terms of quality, delivery speed, delivery reliability, price (cost) and flexibility, is widely understood by those employees who affect whether the task is achieved.

This is represented in figure 3.1 by the arrow linking the top and middle boxes.

A parallel perspective can be identified in the business strategy and organisational behaviour literature. There it is argued that consistency of decision making and action can be induced through the use of strategic controls, management controls or performance management systems. These are usually said to consist of goal setting, performance measurement, feedback and reward systems (Bevan and Thomson, 1992; Bungay and Goold, 1991; Child, 1985; Erban, 1989; Fowler, 1990; Goold and Quinn, 1990; Hrebiniak and Joyce,

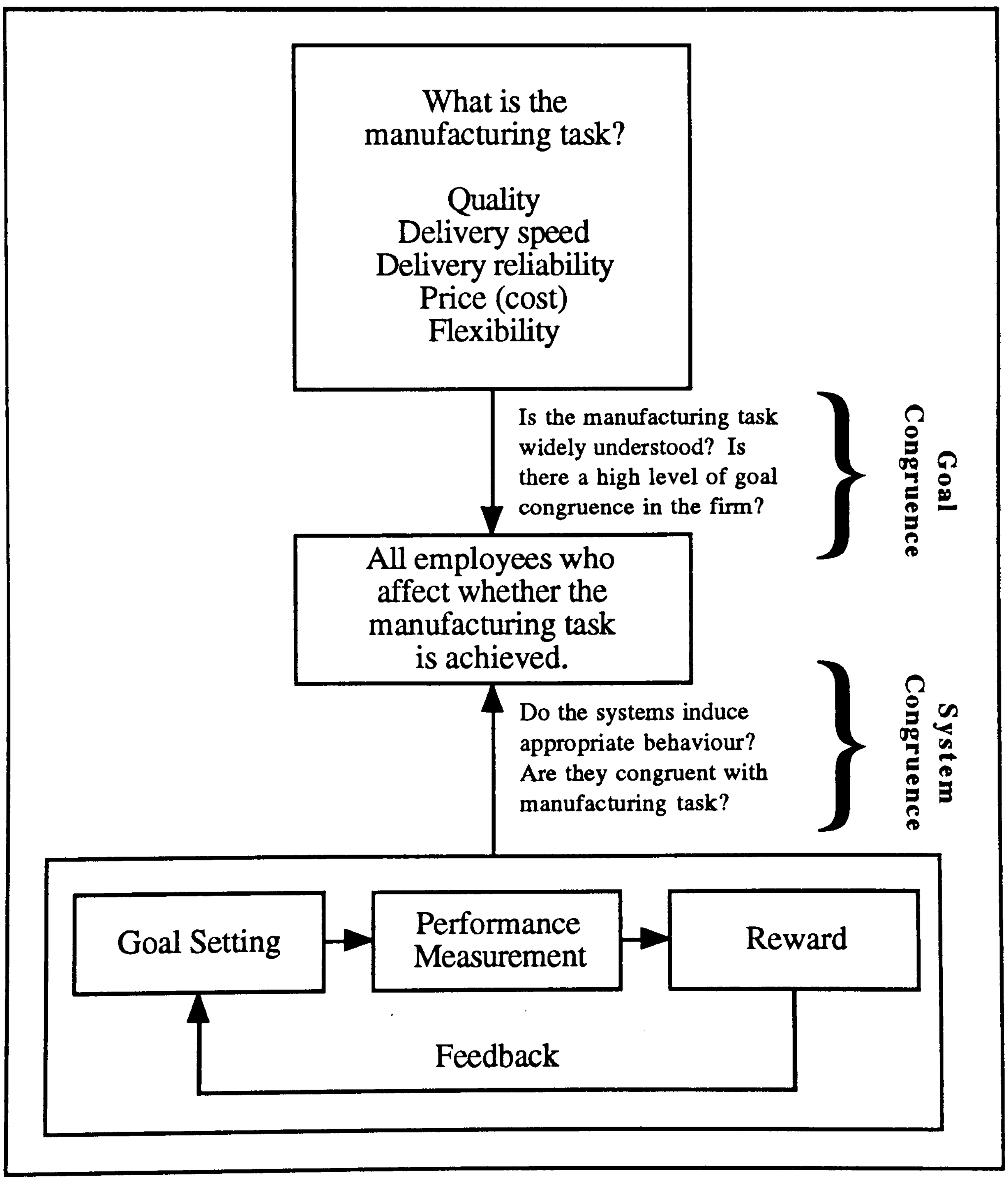
[4] Skinner's second dimension of manufacturing strategy - the policy decisions - which describe how manufacturing should seek to achieve the manufacturing task are assumed to be a separate issue at this stage. As will be seen in chapter seven, however, this tidy academic model does not necessarily reflect reality.

1984; Lorange, 1982; Lorange et al., 1986; Simons, 1991). Hence for the purpose of this thesis a high level of system congruence is said to exist if:

> **-The firm's goal setting, performance measurement, feedback and reward systems are used to induce decision making and action consistent with the manufacturing task.**

This is represented in figure 3.1 by the arrow linking the bottom and middle boxes.

Figure 3.1: The conceptual framework underpinning the research



The conceptual framework shown in figure 3.1, then, highlights the fact that the business strategy, organisational behaviour and organisational culture literatures recognise two primary means of inducing consistency of decision making and action within organisations. The purpose of this research is not simply to test whether this framework applies to the manufacturing environment, but also to determine if the concepts it refers to, namely goal and system congruence, form the basis of a congruence audit which can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy.

3.2: **Gap and propositions**

Leong et al. (1990) have suggested that one of the main reasons that the field of manufacturing strategy has been developing only slowly is that manufacturing strategists have failed to import ideas from other academic disciplines. As the literature review has shown there is widespread agreement as to the appropriate content for a manufacturing strategy, but little understanding of the processes that should be used to develop and implement one. Writers on business strategy, organisational behaviour and organisational culture appear to have something to offer in this regard. It is widely accepted that strategies are realised through consistency of decision making and action (Hayes, Wheelwright and Clark, 1988; Mintzberg, 1978; Skinner, 1974b), and that such consistency can be the result of widely shared values (Child, 1985; Deal and Kennedy, 1982; Ouchi, 1981; Pascale and Athos, 1981), or induced through the use of strategic controls, management controls or performance management systems (Bevan and Thomson, 1992; Bungay and Goold, 1991; Child, 1985; Erban, 1989; Fowler, 1990; Goold and Quinn, 1990; Hrebiniak and Joyce, 1984; Lorange, 1982). Manufacturing strategists implicitly accept these notions (goal and system congruence), but have made no attempt to determine whether they can be exploited in an industrial setting. Indeed all those studies of either goal or system congruence that the author has been able to identify are somewhat narrow in their scope. Even the broadest of them - the work of Dixon, Nanni and Vollmann (1990) - fails to explore the concepts in a truly strategic and holistic sense because it adopts an unconventional view of strategy and focuses primarily on performance measurement. There appears, then, to be a gap in the body of academic knowledge with regard to how the concepts of goal and system congruence can be; (a) operationalised and (b) exploited. The research reported in this thesis sought to fill this gap by showing how an audit based on these concepts could be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy. Of course to do this it was first necessary to develop the congruence audit. Hence the research propositions can be stated as follows:

(a) **That a process which can be used to identify areas of either goal or system incongruence (a congruence audit) can be developed.**

(b) **That such a process can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy.**

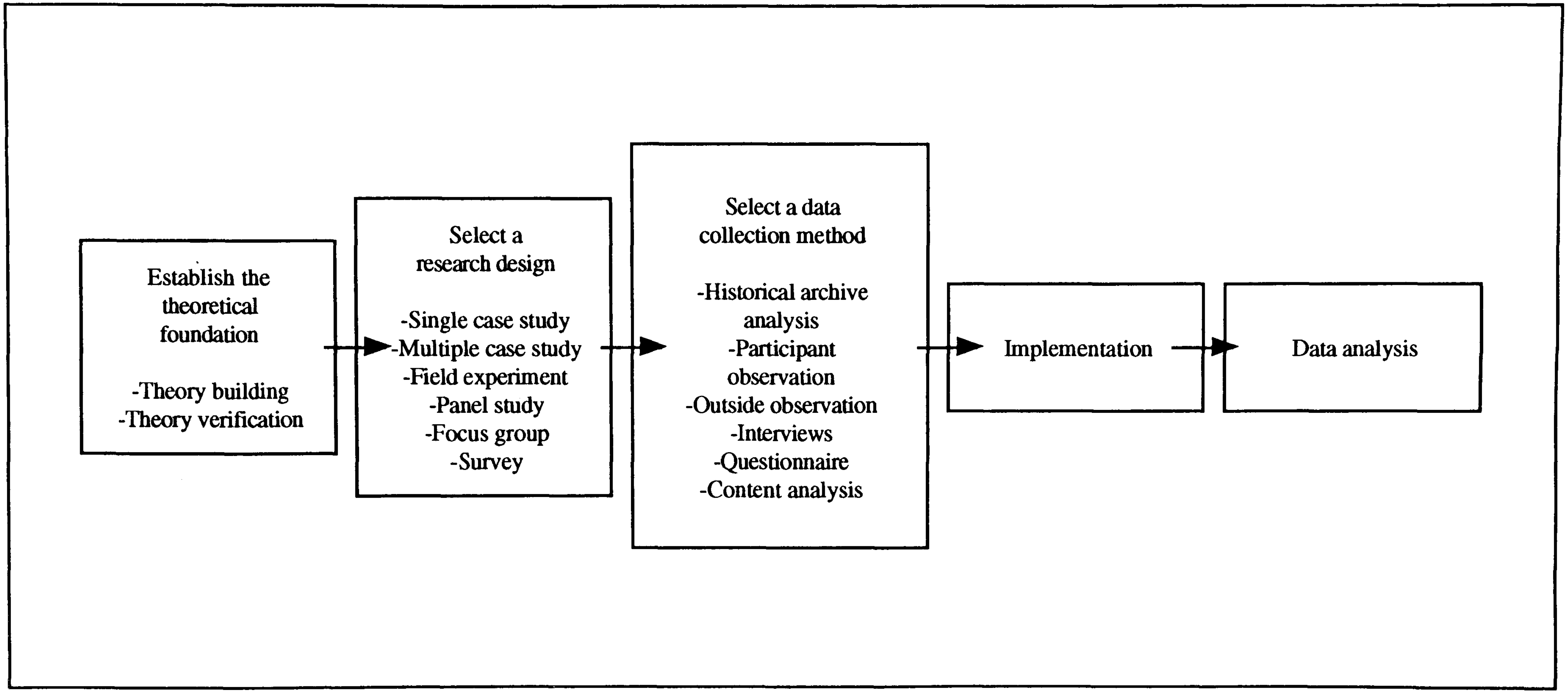
3.3: Research methodology

The research propositions are based on concepts drawn from the manufacturing strategy, business strategy, organisational culture and organisational behaviour literature discussed in chapter 2. The purpose of this section is to explain how the author sought to test them. Figure 3.2 shows the five step model of the P/OM research process proposed by Flynn et al. (1990). This will be used to explain the author's research methodology. The sixth step, publication, has been omitted from figure 3.2. A number of papers relating to the work reported in this thesis, however, have been published (Neely, 1991, 1993a; Neely, Aggarwal and Wilson, 1992; Neely and Wilson, 1991, 1992a, 1992b, 1992c, 1992d, 1992e; Wilson, Neely and Aggarwal, 1993; Wilson, Neely and Chew, 1993).

3.3.1: Theoretical foundation

The main themes identified during the literature review were restated at the

Figure 3.2: A systematic approach for empirical research (Flynn et al., 1990)



beginning of this chapter. These form the theoretical basis of the research reported in this thesis. Flynn et al. (1990) suggest that research can involve either building theories or verifying them.

> "Theory verification is the most widely understood approach. It is based on the scientific method, in which many operations management researchers are grounded. Hypotheses are generated in advance of the study, and they are tested by the data collected...
>
> A theory-building study is based upon a different origin and uses data in a different way... Generally speaking, the origin for a theory-building study is not a hypothesis, but rather, some assumptions, frameworks, a perceived problem or perhaps a very tentative hypothesis" (Flynn et al, 1990, 253).

This research focuses on theory building. That is, it takes an implicit model from the literature and tests whether it can be; (a) operationalised and (b) exploited.

3.3.2: **Research design**

A variety of research designs can be used for empirical P/OM research. These include single or multiple case studies, field experiments, panel studies, focus groups, and surveys. For the type of research reported in this thesis, however, single or multiple case studies are the most appropriate because the development, testing and application of the congruence audit requires the close, personal involvement of the researcher (Flynn et al., 1990). During the course of this investigation the author worked directly with four companies and consulted managers from a further fourteen. In total over one hundred different managers were involved.

The four core collaborators were all small to medium sized manufacturing enterprises[5] (SMEs) based in the East Midlands. Company A produces coin

[5] In this thesis the term SME is used to refer to a manufacturing firm employing fewer than five hundred people.

operated amusement games for the leisure industry and has 400 full-time employees. It operates in what could be called a fashion market and because of this demand for company A's products can vary from 200 to 600 units on a weekly basis.

Company B designs and manufacturers special purpose machine tools for the automotive industry. It employs 85 craftsmen and 25 engineers. Recently the firm has diversified and the managing director is now exploring the possibility of focusing on the design and manufacture of high technology equipment for laser cutting and electro-discharge machining (EDM).

Company C designs, manufactures and installs timber and plastic laminate products for the shopfitting and construction industries. It employs 120 people and underwent rapid growth during the late 1980s. In fact between 1985 and 1990 its turnover increased five fold. Company C, however, still has a "family" feel to it and appears to be struggling to consolidate its position in the market place.

Company D manufactures electronic control equipment for its US parent. It employs 450 people and could be described as world class. The management team are currently actively exploring/implementing:

-Single minute exchange of die (SMED) technology;

-Product based manufacturing;

-Just-In-Time manufacturing;

-Total Quality Management;

-Personnel loss prevention.

Of the remaining fourteen companies three were SMEs, one was a Japanese transplant based in the UK, and the others were companies that the author visited during a three week study tour in Japan. As will be seen later the development and testing of the congruence audit took place primarily in companies A, B, C and D. The author's contact with the remaining fourteen firms was limited to the exploration of the concepts contained in this thesis through panel discussions and semi-structured interviews.

3.3.3: **Data collection methods**

Jick (1979) suggests using multiple data collection methods to enhance the validity of research. Flynn et al. (1990) identify historical archive analysis; participant observation; outside observation; interviews and questionnaires as possible methods. This research involved data collection at two levels. First it focused on the development and testing of the congruence audit. Hence data which showed how the audit could be improved had to be gathered. These data were collected via the author's participant observation. Second each application of the congruence audit involved data collection. These data were gathered during structured interviews and group discussions. Historical archive analysis was also used when appropriate.

3.3.4: **Implementation**

Partly because of the four core collaborator's interests and partly through a conscious research design, different pairs of firms were involved in each phase of the research. This resulted in the congruence audit being developed iteratively both within and across the firms. The term "iteratively" is used intentionally in this context. The research began with the author developing a pilot version of the goal congruence audit. This was tested formally, in companies A and B, and informally during discussions with a number of managers from firms in the wider sample. Then, once improvements to the congruence audit had been identified, the author set out to explore whether it was possible to develop a system congruence audit. Initially this involved shadowing managers in company A to establish which systems influenced them. Next a series of semi-structured interviews were held with managers from firms in both the UK and Japan to determine whether the same systems influenced them. Then a pilot version of the system congruence audit was developed. This was tested in company C. Finally an integrated congruence audit, based on the experience that the author had gained during the development and testing of the pilot versions of the goal and system congruence audits, was developed. This "integrated" congruence audit, involving both group discussions and structured interviews, was applied to companies C and D. The fact that the firms involved in the study vary both in size and location, and that they trade in different industrial sectors implies that the congruence audit is valid for a variety of companies[6].

As figure 3.3 shows, then, the development and testing of the congruence audit involved three main phases. Broadly these can be summarised as follows:

-Phase 1: The development and testing of the goal congruence audit.

-Phase 2: The development and testing of the system congruence audit.

-Phase 3: The integration of the two previous audits and the application of the resultant congruence audit.

Companies A and B were involved in phase one. This consisted of:

(a) The development of a pilot version of the goal congruence audit.

(b) Eighteen structured interviews, thirteen in company A and five in company B, during which the raw data required by the pilot version of the goal congruence audit were collected.

(c) Analysis of these data.

(d) Feedback to the companies concerned.

(e) Identification of ways in which the pilot goal congruence audit could be improved.

Companies A and C were involved in phase two. This consisted of:

(a) Shadowing five managers in company A to establish which systems influenced them.

(b) Semi-structured interviews with managers from fourteen other companies to determine whether they were influenced by the same

[6] Once the goal congruence audit had been developed an MSc student, working directly with the author, applied the same methodology to two Swedish firms (Aldrin, 1991). This lends credence to the argument that the methodology is both widely applicable and easily transferable.

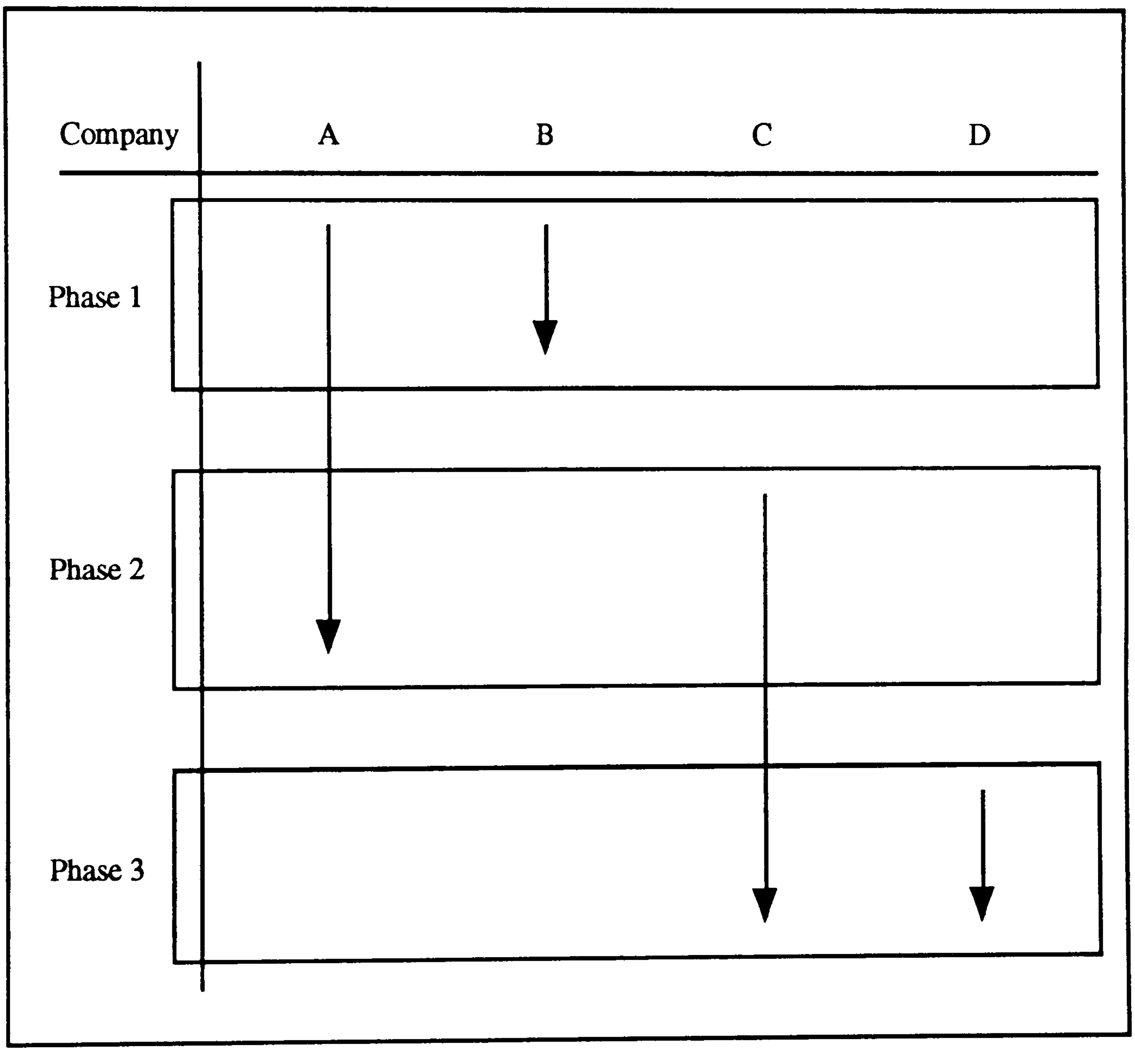
systems.

(c) The development of a pilot version of the system congruence audit.

(d) Two structured interviews in company C to test whether the data collection methods employed in the pilot version of the system congruence audit were appropriate.

(e) Identification of ways in which the pilot system congruence audit could be improved.

Figure 3.3: Iterative development of the congruence audit



Companies C and D were involved in phase three. This consisted of:

(a) The integration of the pilot versions of the goal and system congruence audits. This resulted in the congruence audit.

(b) The application of the congruence audit to company C. This involved a group discussion with five senior managers, followed by fifteen structured interviews.

(c) The application of the congruence audit to company D. This involved a group discussion with eight senior managers, followed by twelve structured interviews.

(c) Analysis of these data.

(d) Feedback to the companies concerned.

3.3.5: **Data analysis**

As mentioned in section 3.3.3 data were collected at two levels during this research. First the author gathered data on the utility, reliability and validity of the audits via his participant observation. Due to their inherent subjectivity these data cannot be formally analysed, but they are discussed in chapters 4 and 5 as they form part of the author's experience and hence will have shaped the design of the congruence audit.

Second data were collected during the group discussions and structured interviews which formed part of the congruence audits. Through a conscious research design the majority of these data were quantifiable. This meant that the author was able to immediately analyse and feed the data back to the research participants using a laptop computer. The interviewee, or the management group, was then given the chance to comment on the analysed data, hence minimising the risk of interviewer bias. At the end of each study the author also presented the aggregate results of the study to either a group of the firm's managers or the interviewees. Once again everyone was given the chance to comment on the analysis. Thus care was taken to maximise the reliability and validity of the data collected during the audit process.

3.4: **Summary**

In this chapter the main themes from the literature review have been summarised and the theoretical model which underlies the research explained. Following this two research propositions were stated:

(a) That a process which can be used to identify areas of

either goal or system incongruence (a congruence audit) can be developed.

(b) **That such a process can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy.**

The research methodology has also been detailed. The main data collection methods were structured interviews, group discussions and participant observation, although these were supplemented by historical archive analysis when appropriate. Three phases to the research were identified. Phases one and two involved the development and testing of processes for identifying areas of either goal or system incongruence. Phase three involved the integration of these processes and the application of the resultant congruence audit in two firms. Each of these phases and the research methodologies involved in them will be discussed more fully in the following chapters.

CHAPTER 4: THE GOAL CONGRUENCE AUDIT

CHAPTER 4: THE GOAL CONGRUENCE AUDIT[7]

> "If we define organisation as collective action in the pursuit of common mission (a fancy way of saying that a group of people under a common label - whether an IBM or a United Nations or a Luigi's Body Shop - somehow find the means to cooperate in the production of specific goods and services), then strategy as perspective focuses our attention on the reflections and actions of the collectivity - how intentions diffuse through a group of people to become shared as norms and values, and how patterns of behaviour become deeply ingrained in the group. Ultimately, it is this view of strategy that offers us the best hope of coming to grips with the most fascinating issue of all, that of the organisational mind" (Mintzberg, 1987, 21).

4.0: Introduction

So far this thesis has concentrated on the theoretical dimension of the research - the literature review and conceptual framework. In the next two chapters, however, the emphasis will change as the pilot processes used to identify areas of goal and system incongruence are described. This chapter will focus on the development and testing of the first of these processes - the goal congruence audit.

In chapter 3 it was stated that a high level of goal congruence could be said to exist in a firm if:

-The manufacturing task, defined in terms of quality, delivery speed, delivery reliability, price (cost) and flexibility, is widely understood by those employees who affect whether the task is achieved.

[7] Much of the work presented in this chapter is based on a report written by the author for the U.K. Department of Trade and Industry entitled: Goal Congruence - A Conceptual Overview and a Measurement Methodology (Neely and Wilson, 1992d).

Hence auditing the level of goal congruence in a firm involves determining how widely the manufacturing task is understood. There are two dimensions to this problem. The first comprises collecting data which show how different individuals perceive the manufacturing task. The second involves comparing and contrasting their perceptions.

The rest of this chapter has been divided into seven sections. The first four describe the development of the goal congruence audit, the remainder focus on its testing. In section 4.1 the problems associated with the identification of areas of goal incongruence will be discussed. In section 4.2 the Analytic Hierarchy Process (Saaty, 1980), which was one of the main data collection techniques used in this research, will be explained. In section 4.3 the full data collection methodology will be detailed and in section 4.4 the various ways in which the data can be compared will be explored.

Once the goal congruence audit had been developed it was piloted in two firms. The results of the pilot studies will be presented in section 4.5. Flynn et al. (1990, 265-266) say that considerations of reliability and validity should underlie every step of the research process. "Reliability... measures the ability to replicate the study... Validity measures two things. First, does the item or scale truly measure what it is supposed to measure? Second, does it measure nothing else?" In section 4.6 the reliability and validity of the pilot version of the goal congruence audit will be discussed. The purpose of this discussion is to identify ways in which the goal congruence audit can be improved[8]. An additional question, that of the utility or usefulness of the audit, will also be addressed. The chapter will be summarised in section 4.7.

4.1: **Methodological issues**

According to the marketing perspective, organisations achieve their goals by satisfying their customers with greater effectiveness and efficiency than their competitors (Kotler, 1984). The terms effectiveness and efficiency are used

[8] As will be seen in chapter 6 these improvements were incorporated into the integrated goal congruence audit during the course of this research.

precisely in this context. Effectiveness refers to the extent to which customer requirements are met, while efficiency is a measure of how economically the firm's resources are utilised when providing a given level of customer satisfaction (Barnard, 1962). If one accepts Barnard's definitions and Kotler's assertion, then the manufacturing function can be said to contribute to the attainment of the organisation's goals by efficiently providing products and services which meet, or exceed, the customer's requirements. This is an important point because it explicitly identifies the two dimensions of the manufacturing task. The first is the external one - what does manufacturing have to do to ensure that the firm's customers are satisfied? The second is the internal one - how efficiently can manufacturing do this?

As discussed in chapter 2, it is widely accepted in the manufacturing strategy literature that the manufacturing task can be defined using the generic terms quality, delivery speed, delivery reliability, price (cost) and flexibility (Leong et al., 1990). However defining the manufacturing task in this way introduces two problems. First, it means that manufacturing strategists tend to focus on the external dimension of the manufacturing task (Hill, 1985; Hayes, Wheelwright and Clark, 1988; Platts and Gregory, 1990). Hence they often fail to acknowledge explicitly internally important issues such as minimising manufacturing lead times or costs. Second, despite Leong et al's (1990) assertion, confusion still exists over what the generic terms quality, delivery speed, delivery reliability, price (cost), and flexibility actually mean. Wheelwright (1984), for example, uses flexibility in the context of varying production volumes, while Tunälv (1992) uses it to refer to a firm's ability to rapidly introduce new products. And, as shown in figure 4.1, other authors such as Garvin (1987), Gerwin (1987), Schonberger (1990), Slack (1987) and Stalk (1988) have all pointed out that the generic terms quality, time[9] and flexibility encompass different dimensions.

Any methodology for auditing the level of goal congruence in a firm must take

[9] Delivery speed and delivery reliability both fall under the category of time. They are shown as factors T3 and T4 respectively in figure 4.1.

account of these two problems because if it does not there is a danger that goal incongruence may be masked by people using the same generic terms to talk about different concepts or vice versa. Hence it was decided that the pilot version of the goal congruence audit would take, as one of its units of analysis, the factors shown in figure 4.1 rather than the generic terms quality, delivery speed, delivery reliability, price (cost) and flexibility.

Figure 4.1: The multiple dimensions of quality, time, cost and flexibility

QUALITY	TIME	FLEXIBILITY
Q1: Performance	T1: Manufacturing lead time	F1: Material quality
Q2: Features	T2: Rate of product introduction	F2: Output quality
Q3: Reliability	T3: Delivery lead time	F3: New product
Q4: Conformance	T4: Due-date performance	F4: Modify product
Q5: Technical durability	T5: Frequency of delivery	F5: Deliverability
Q6: Serviceability	**COST**	F6: Volume
Q7: Aesthetics	C1: Manufacturing cost	F7: Mix
Q8: Perceived quality	C2: Value added	F8: Resource mix
Q9: Humanity	C3: Selling price	
Q0: Value	C4: Running cost	
	C5: Service cost	

Figure 4.2 shows the sort of data that has to be collected in order to audit the level of goal congruence in a firm. The box to the right of the one which refers to the foremen is split into two columns, A and B. Each column represents a different person. In this example, foreman A believes that factor Q1, product performance quality[10], is the most important element of the manufacturing task; that factor T1, manufacturing lead time, is the second most important; and that factor C1, manufacturing cost, is the third. That is, foreman A thinks that the manufacturing function can best contribute to the overall success of the business if it quickly and cheaply manufactures products which perform well in the field. Foreman B, on the other hand, believes that the manufacturing function can best contribute by continually producing new (factor T2) and aesthetically pleasing

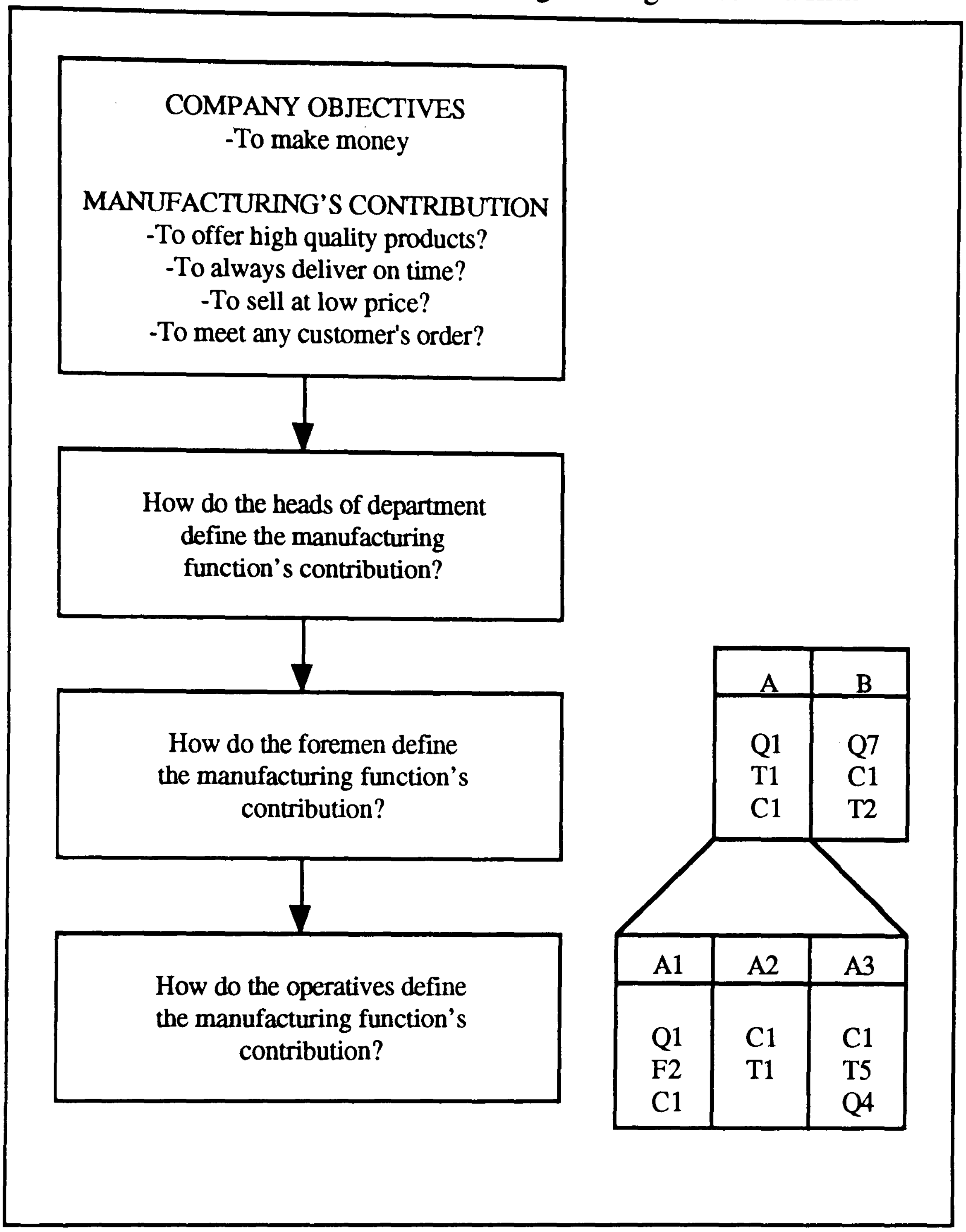
[10] The key to these abbreviations is provided by figure 4.1.

(factor Q7) products at low cost (factor C1).

At the next lower level in the organisation only those employees who work for foreman A, operatives A1 through to A3, are shown. In this example, operative A1 believes that factor Q1, producing products of high performance quality, is the most important part of the manufacturing task, whilst operatives A2 and A3 believe that the manufacturing function can best contribute to the success of the business by minimising manufacturing costs, factor C1. Hence it can be said that a higher level of goal congruence exists between foreman A and operative A1, than between foreman A and operatives A2 and A3 with respect to factor Q1, product performance quality. Of course such differences of opinion may not be divisive. Indeed it can be argued that they may stimulate debate and hence innovation, or that they are a function of an individual's role (Hailey et al., 1991; Pascale, 1990). And so it is important to recall at this stage that the purpose of this research is not to provide a tool for surfacing and then eliminating the causes of goal incongruence, but to establish whether the concept can be operationalised and used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy.

As figure 4.2 shows auditing the level of goal congruence in a firm involves more than merely stating what the manufacturing task constitutes, as one also has to prioritise its elements (New, 1992b; Wheelwright, 1978). Hence one of the main methodological question that needs to be addressed is; how can data which show how an individual prioritises the various elements of the manufacturing task be collected. The data shown in figure 4.2 have simply been placed in rank order of importance. The problem with ranked data, however, is that they provide no indication of the gap between two factors (Anastasi, 1988; Meddis, 1984). Take the previous example. Foreman A may have believed that factor Q1 was by far the most important, whereas operative A1 may have thought that it was only marginally more important than factors F2 and C1. Hence, although the ranked data suggest that there is a high level of goal congruence between foreman A and operative A1 with regard to factor Q1, a considerable difference of opinion may exist.

Figure 4.2: Auditing the level of goal congruence in a firm



An alternative approach would be to ask different individuals to rate each of the factors, perhaps using a scale of one through to nine, or unimportant through to very important. This approach, however, can be criticised for being too subjective as there is a danger that different people will attribute varying intensities to the scale itself (Anastasi, 1988; Nunnally, 1980). Continuing with the previous example. Foreman A may believe that factor Q1 is by far and away the most important, but may only rate it as fairly important on the scale because he never rates anything to do with his job as important. Operative A1, on the other hand, may frequently rate things as important because the term does not provoke the same feeling of intensity for him. There is a danger that this could bias the data collection process.

In his 1978 study, Wheelwright used a different data collection methodology when he asked the vice-presidents (VP) and manufacturing managers (MM) of a firm to split one hundred points between the generic dimensions of cost, quality, dependability and flexibility to reflect their importance (see table 4.1). This overcomes the problems raised above, but introduces a new one as many people find it difficult to split points between such closely inter-related dimensions (Anastasi, 1988; Nunnally, 1980). For all the above reasons, pairwise comparisons, based on Saaty's (1980) Analytic Hierarchy Process, were used in the pilot studies. The next section contains more detail on the Analytic Hierarchy Process. The full data collection methodology used in the pilot studies is described in the following one.

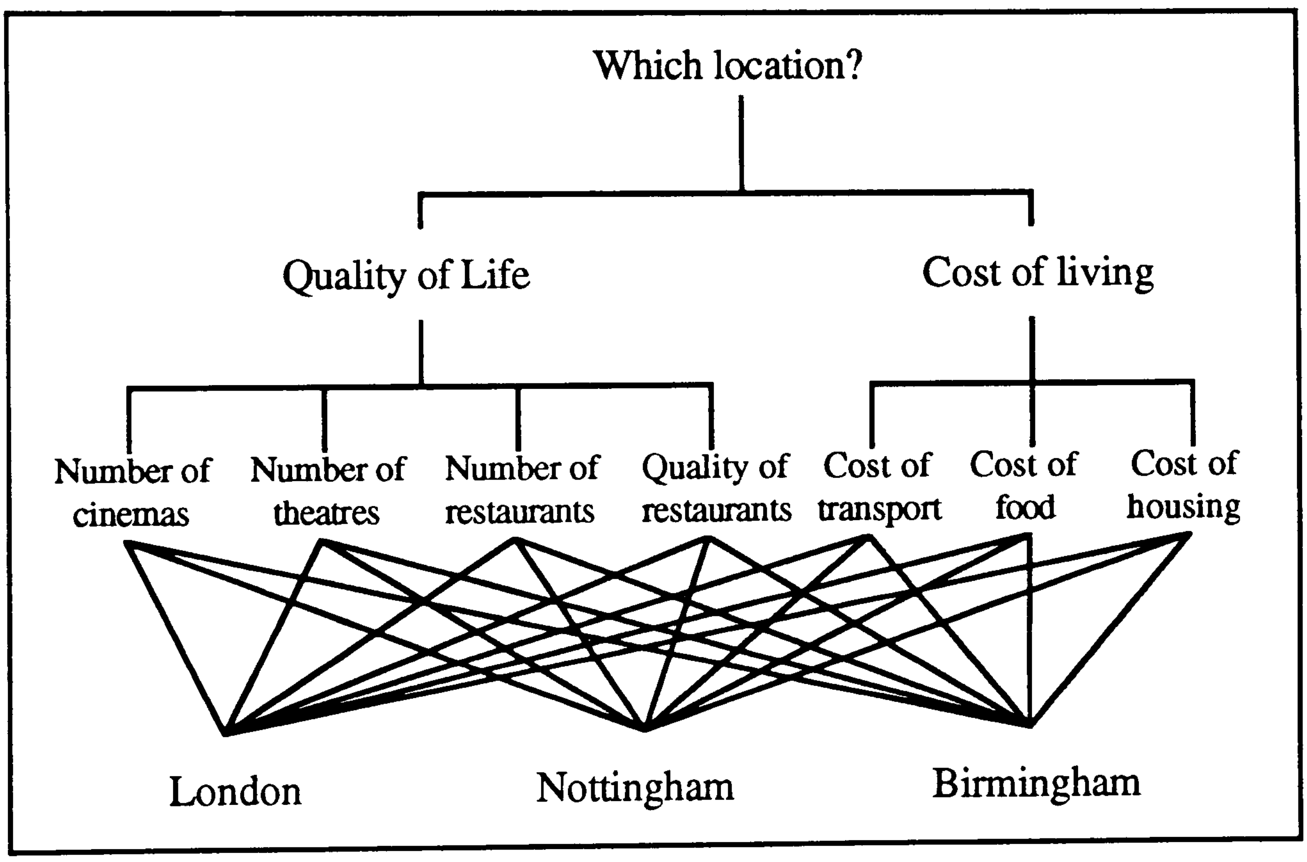
Table 4.1: Wheelwright's (1978) method for determining goal congruence

	Cost		Quality		Dependability		Flexibility	
	VP	MM	VP	MM	VP	MM	VP	MM
Product 1								
As is	42	44	17	15	25	26	16	15
Should be	28	46	24	16	31	26	17	12
Product 2								
As is	26	20	37	43	24	22	13	15
Should be	26	30	36	38	26	20	12	12

4.2: Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) was designed as a decision making aid and is especially suitable for complex decisions which involve the comparison of decision elements which are difficult to quantify (Saaty, 1980). It is based on the assumption that when faced with a complex decision the natural human reaction is to cluster the decision elements according to their common characteristics. If one were to have been offered three identical jobs in London, Nottingham, and Birmingham, for example, the choice as to which job to accept might rest, among other things, on location. At the next lower level in the decision hierarchy, two factors grouped under the generic heading location might be; quality of life and cost of living. And at the next lower level, quality of life might be split into; number of theatres, number of cinemas, number of restaurants and standard of restaurants, while the category cost of living might include factors such as; cost of transport, cost of food and cost of housing.

Figure 4.3: Partial decision hierarchy for job selection based on location



In reality, the decision maker must identify and categorise all of the decision elements which are likely to affect the outcome of the decision before beginning the pairwise comparison process. For the sake of simplicity figure 4.3 shows only a partial decision hierarchy and ignores some issues which may be important; e.g. education facilities, local services, distance from relatives and friends, etc.

Once the full decision hierarchy has been produced, and the decision maker is happy that it contains all the relevant decision elements, the pairwise comparison process can begin. The raw data are produced as the decision maker answers two questions. The first is of the form; "which, in your opinion, is the better place to live with regard to the number of cinemas - London or Nottingham". If the decision maker were to reply; "London", then, in this example, the second question would be of the form; "how much better is London than Nottingham". The decision maker would be expected to respond to this question by identifying the number on Saaty's scale which best matches the strength of his feeling (see table 4.2). Continuing with the previous example, then, if the decision maker thought that London was a much better place to live than Nottingham, he would respond to the second of the above questions by saying; "London is much better than Nottingham - a five on the scale". The process is known as pairwise comparison because each pair of factors have to be compared. Once the decision maker has compared London and Nottingham, he would be asked to compare London and Birmingham and then Nottingham and Birmingham. The data generated during this process are recorded in a three by three matrix as shown in figure 4.4.

Figure 4.4: Sample three by three matrix with raw data

	L	N	B
London	1	5	8
Nottingham	1/5	1	3
Birmingham	1/8	1/3	1

The matrix can be read as follows. In column one (C1), row one (R1) London is compared with London and as there can be no preference, one, meaning equally as good is entered. In column two, row one (C2R1) London is compared with Nottingham and judged to be much better. Hence a five is entered in C2R1. The reciprocal value is entered in C1R2 as this refers to the comparison of Nottingham with London. In C3R1 London is compared with Birmingham and this time judged to be very much better, so an eight is entered in the matrix. Once again the reciprocal value is entered in C1R3. Finally Nottingham is compared with Birmingham and as Nottingham is judged to be slightly better a three is entered in C3R2.

Table 4.2: The pairwise comparison scale (Saaty, 1982)

Importance	Definition	Explanation
1	Equal importance	Two elements contribute equally to the property
3	Weak importance of one over another	Experience and judgment slightly favour one element over another
5	Essential or strong importance	Experience and judgment strongly favour one element over another
7	Very strong or demonstrated importance	An element is strongly favoured and its dominance is demonstrated in practice
9	Absolute importance	The evidence favouring one element over another is of the highest possible order
2, 4, 6, 8	Intermediate values between adjacent scale values	Compromise is needed between two judgments
Reciprocals	If activity i has one of the above non-zero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i	

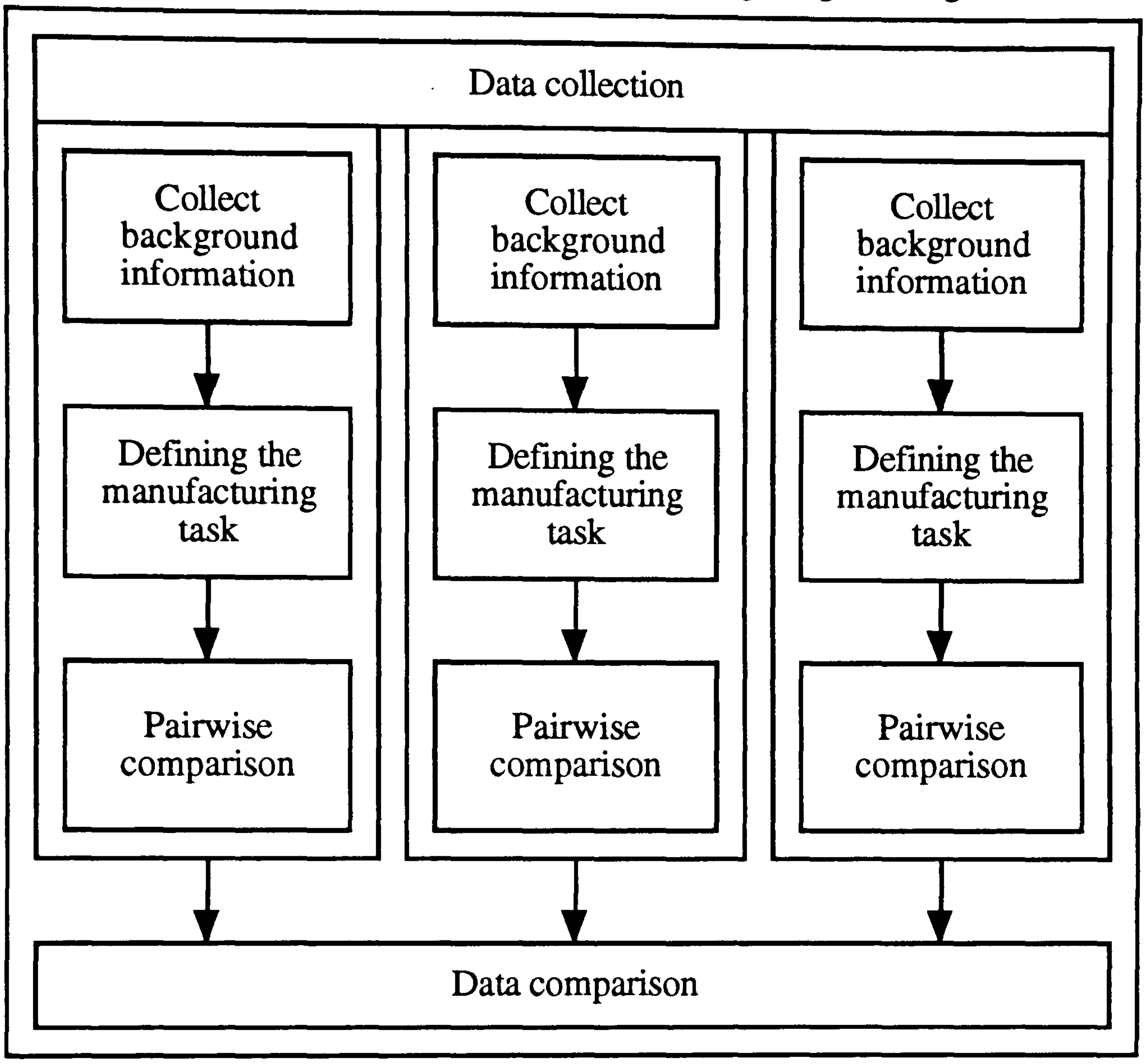
To complete a three by three matrix, then, three pairwise comparisons have to be made. The third comparison actually provides redundant information, as the decision maker's preference can be calculated from the ratios given by the first two. The Analytic Hierarchy Process uses this redundant information to check the consistency of the decision maker's answers. Imagine, for example, that the decision maker had said that London was slightly better than both Nottingham and Birmingham. When he is asked to compare Nottingham and Birmingham logically he would be expected to have no preference. If, however, he said that Nottingham was better than Birmingham then the interviewer could probe this inconsistency and hence enhance the validity of the raw data.

More detail on the use of the Analytic Hierarchy Process is provided by Frazelle (1985); Gass (1985); Harker (1989) and Saaty (1980). For the purpose of this thesis, however, it is sufficient to know that once the raw data have been collected they can be converted into; (a) a set of preference weightings, and (b) a consistency ratio. The preference weightings indicate the relative preferences or priorities that the decision maker assigns to each of the decision elements. As their sum is equal to unity, or one hundred percent, the preference weightings provide a means of both ranking and rating data while overcoming the problems discussed in the previous section. The consistency ratio is simply a measure of the consistency of the decision maker's responses and can be used as an indicator of the validity of the preference weightings. Appendix II explains how the preference weightings and the consistency ratio are calculated from the raw data. In the next section the way in which the Analytic Hierarchy Process was used in the goal congruence audit will be explained as the structured data collection process used in the pilot studies is documented.

4.3: **Data collection process**

As mentioned at the beginning of this chapter auditing the level of goal congruence in an organisation involves; (a) collecting data which show how different individuals perceive the manufacturing task and (b) comparing and contrasting their perceptions. The previous two sections have discussed some of the associated methodological issues. This and the next one describe the actual data collection and comparison processes used. As figure 4.5 shows, together these two processes constitute the pilot version of the goal congruence audit.

Figure 4.5: Data collection and comparison in the pilot goal congruence audit



The principal data collection technique adopted in the pilot version of the goal congruence audit was the structured interview. This was chosen because of the need to gather comparable data from different individuals. As figure 4.5 shows each interview consisted of the three stages. These are detailed below.

4.3.1: **Stage 1 - background information**

Stage 1 - the collection of the background information - was designed to help the interviewee relax and furnish the interviewer with information that may prove relevant in the subsequent discussions. Accordingly open ended questions based on the check sheet shown in figure 4.6 were asked during this stage.

Figure 4.6: Check sheet used during stage one

Name:
Length of service:
Brief history of career:
Job title:
Accountable to whom:
Accountable for what:
Main Duties:
How is your performance measured:
What are your objectives:
How do your objectives relate to those of the firm:

4.3.2: Stage 2 - discussion

The second stage of each interview involved a discussion of what the generic terms quality, time, cost and flexibility meant to the interviewee. The purpose of this stage was to encourage the interviewee to think about the various dimensions of the manufacturing task and to check the comprehensiveness of the list of factors shown in figure 4.1. During this stage each interviewee was asked the following questions:

-What factors relating to quality, time, cost and flexibility do you think are important to the long run success of this company?

-What factors relating to quality, time, cost and flexibility do you think are important to this firm's customers?

A series of probing questions were used to ensure that each of the generic dimensions were explored fully. First the interviewee was simply asked to talk about the generic category under examination. Second they were prompted with a comment along the lines of; "are there any other dimensions of quality which you think are important to the long run success of this firm". Finally the interviewer provided a definition of each of the specific criteria shown in figure 4.1 and asked the interviewee about it. Figure 4.7 shows a part of the check sheet used to collect data on quality generated during the second stage of the interview. Similar check sheets were used for the generic dimensions of time, cost and flexibility.

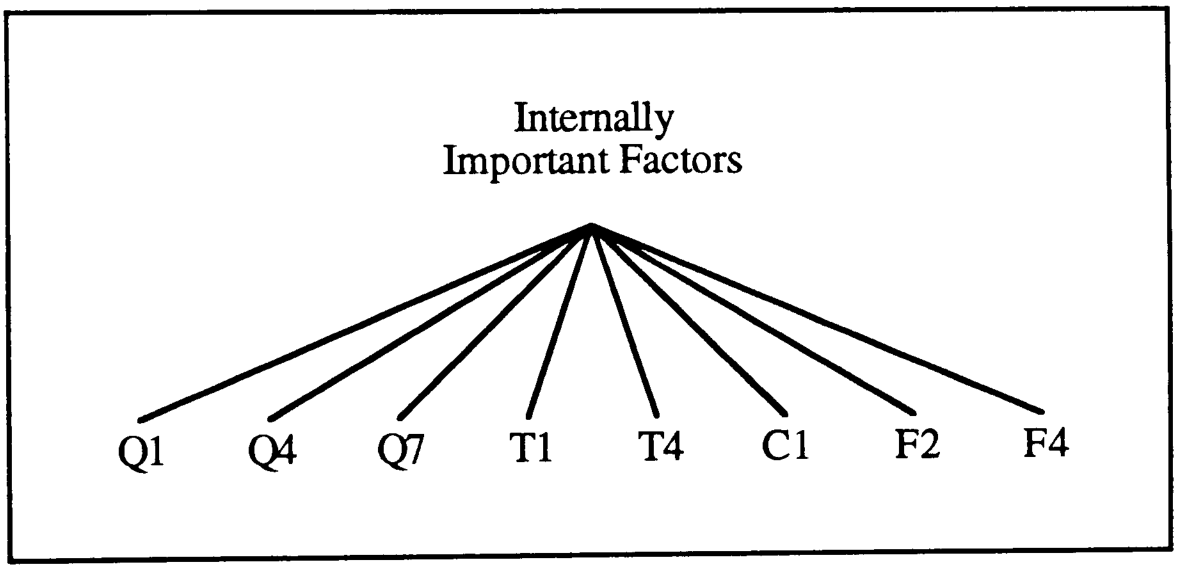
Figure 4.7: Check sheet used during stage two

	Level of Identification		
	Probe level 1	Probe level 2	Probe level 3
Performance			
Internally Important			
Externally Important			
Features			
Internally Important			
Externally Important			
Reliability			
Internally Important			
Externally Important			
Conformance			
Internally Important			
Externally Important			

4.3.3: **Stage 3 - pairwise comparisons**

The output from the second stage of the interview was a list of factors which the interviewee considered to be either internally (to the company) or externally (to the customer) important. In the third stage the interviewee was asked to select and then define in their own terms the eight factors[11] which they thought were the most internally important and the eight factors which they thought were the most externally important. The definitions were requested for two reasons. First so that any goal incongruence due to confusion over the terminology could be identified and second so that if the interviewee defined a factor which was missing from the list shown in figure 4.1 it could be added. Figure 4.8 shows the resultant single level decision hierarchy. It should be noted that during the course of each interview two such decision hierarchies were produced. The first corresponded to those things that the interviewee believed were internally important and the second identified those factors that they thought were externally important.

Figure 4.8: Single level hierarchy for pairwise comparison

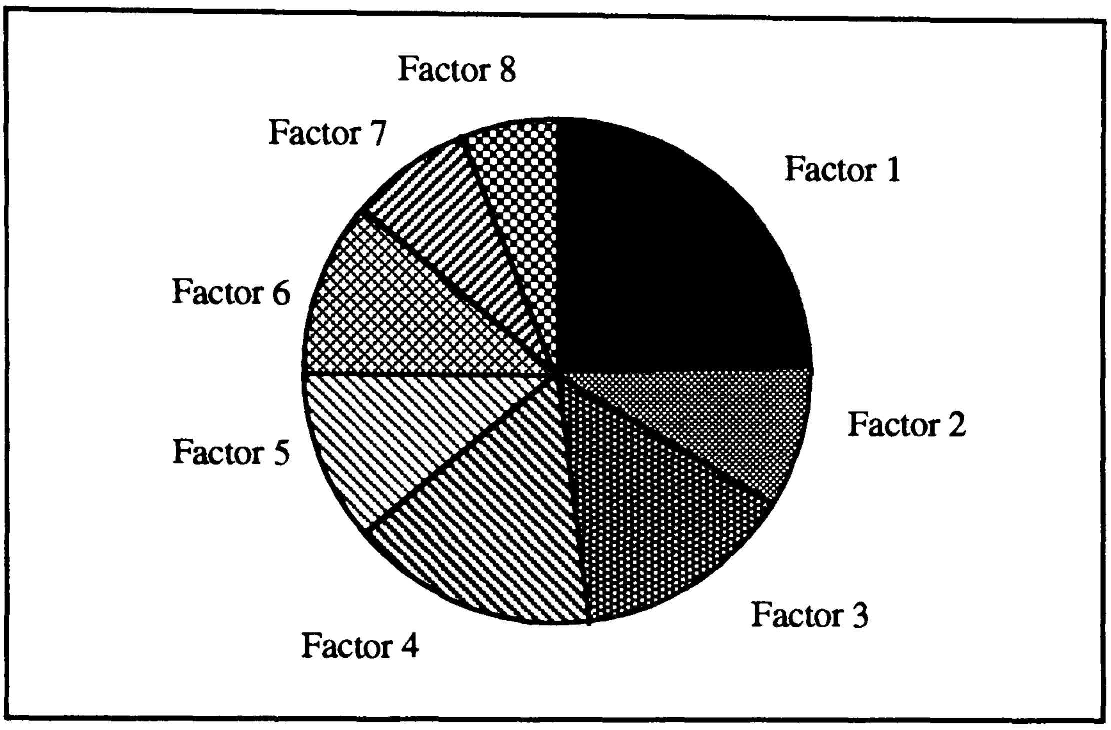


Next Saaty's (1980) pairwise comparison process was used to determine how each interviewee prioritised the factors in the decision hierarchies. The interviewee was first asked which of two factors, factor A or factor B, was most important. And then asked to identify the number on Saaty's scale (see table 4.2) which most accurately matched the strength of their feeling. The terms factor A and factor B were used to ensure that the interviewee had to refer back to the definitions they had already documented, thereby forcing them to check that they were being consistent in the use of their terminology. The

11 Saaty (1980) suggests that no more than ten sets of factors should be included in the pairwise comparison process. If there are too many factors the inconsistency in the decision maker's response is likely to become unacceptable. If there are too few the manufacturing task may be over-trivialised. Hence eight factors seemed to be a reasonable compromise.

collected data were analysed immediately using a spreadsheet on a laptop computer and represented on a pie-chart where the size of the pie reflected the importance the interviewee had assigned to the factor. Figure 4.9 shows an example of this.

Figure 4.9: Sample pie-chart as part of immediate feedback



Once the pie-chart had been produced the interviewee was asked whether they thought it accurately reflected their opinions. If they disagreed with the prioritisations, the appropriate pairwise comparisons were repeated. This iterative process, which continued until the interviewee was satisfied, was used to enhance the reliability of the data. Appendix II contains a detailed description of how the data were analysed and also some comments on the consistency check. As mentioned earlier, a by-product of the pairwise comparison process is the generation of redundant data. These data were used to measure the consistency of the interviewee's responses. If the consistency ratio were poor (greater than 10%) the interviewer had the option of either probing for more information or aborting the interview.

4.4: **Data comparison process**

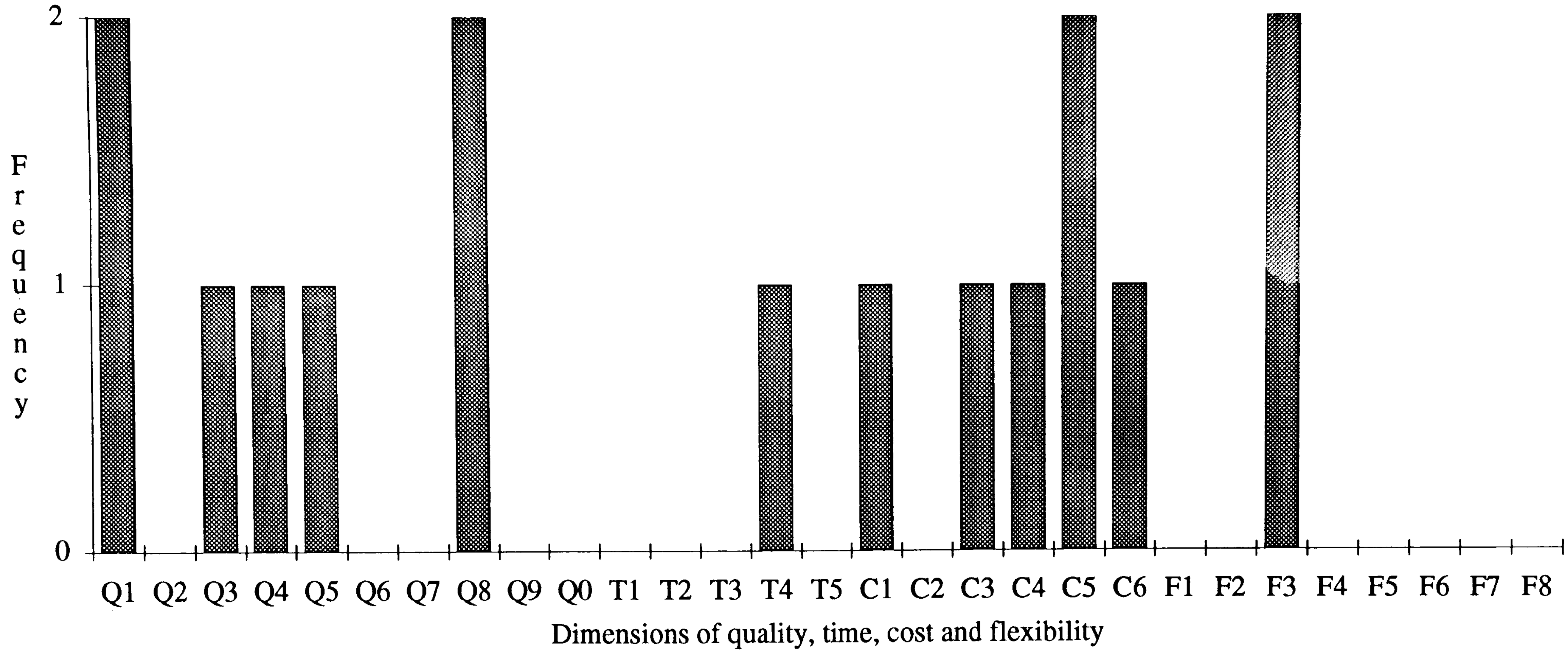
Table 4.3 shows a sample of the data available at the end of each interview. The data reflect an individual interviewee's perception of the manufacturing task. As indicated by figure 4.5, however, the level of goal congruence in a firm can only be audited by comparing and contrasting the perceptions of different interviewees. Hence a series of interviews have to be conducted. This section discusses the ways in which the data gathered during such different interviews can be compared.

Table 4.3: Sample of the data produced during each structured interview

Internally Important Factors	Externally Important Factors
Q1 - Performance (22%)	Q1 - Performance (26%)
Q5 - Durability (5%)	Q3 - Reliability (8%)
Q8 - Perceived quality (8%)	Q6 - Serviceability (2%)
T4 - Due date (11%)	Q0 - Value (20%)
C1 - Manufacturing cost (28%)	T4 - Due date (12%)
C3 - Selling price (22%)	C3 - Selling price (23%)
C5 - Service cost (4%)	C4 - Running cost (4%)
F3 - New product (2%)	F4 - Modification (4%)

The output of each interview (see table 4.3) is a function of what factors the interviewee thinks are important and how important they think they are. Hence there are two generic types of data comparison that can be conducted. The first simply involves comparing which factors different interviewees identify as important. The second involves comparing how important they think these factors are. Figure 4.10 shows the frequency with which the factors shown in table 4.1 were identified as internally important by the managing and financial directors of company B (see section 4.5.2). This visualisation, and hence data analysis technique, falls into the first of the two categories identified above as it focuses on which factors are seen as important, rather than how important they

Figure 4.10: Factors identified as internally important by the managing and financial directors of company B



are seen to be.

The interviewee profile shown in figure 4.11, on the other hand, provides more data as it not only identifies which factors the managing and financial directors of company B saw as important, but also how important they believed them to be. Hence this visualisation, and data analysis technique, falls into the second of the categories identified above. As will be seen in the next section the using both of these data comparison processes to analyse the data gathered during the pilot studies provided a useful insight into the nature of goal congruence.

4.5: **Pilot studies**

Sections 4.3 and 4.4 described the data collection and comparison processes which together constitute the pilot version of the goal congruence audit. As mentioned in chapter 3, once the audit had been developed it was piloted in two firms. The purpose of the pilot studies was to test the reliability, validity and utility of the audit, thereby identifying ways in which it could be improved. In total 18 structured interviews were conducted - 13 in company A and 5 in company B. The sample of interviewees was selected so that data could be collected which enabled the reliability, validity and utility of the audit to be assessed; (a) through the organisation's hierarchy, (b) across the organisation's functions and (c) over time. Sections 4.5.1, 4.5.2 and 4.5.3 detail the data[12] relating to these three pilot studies.

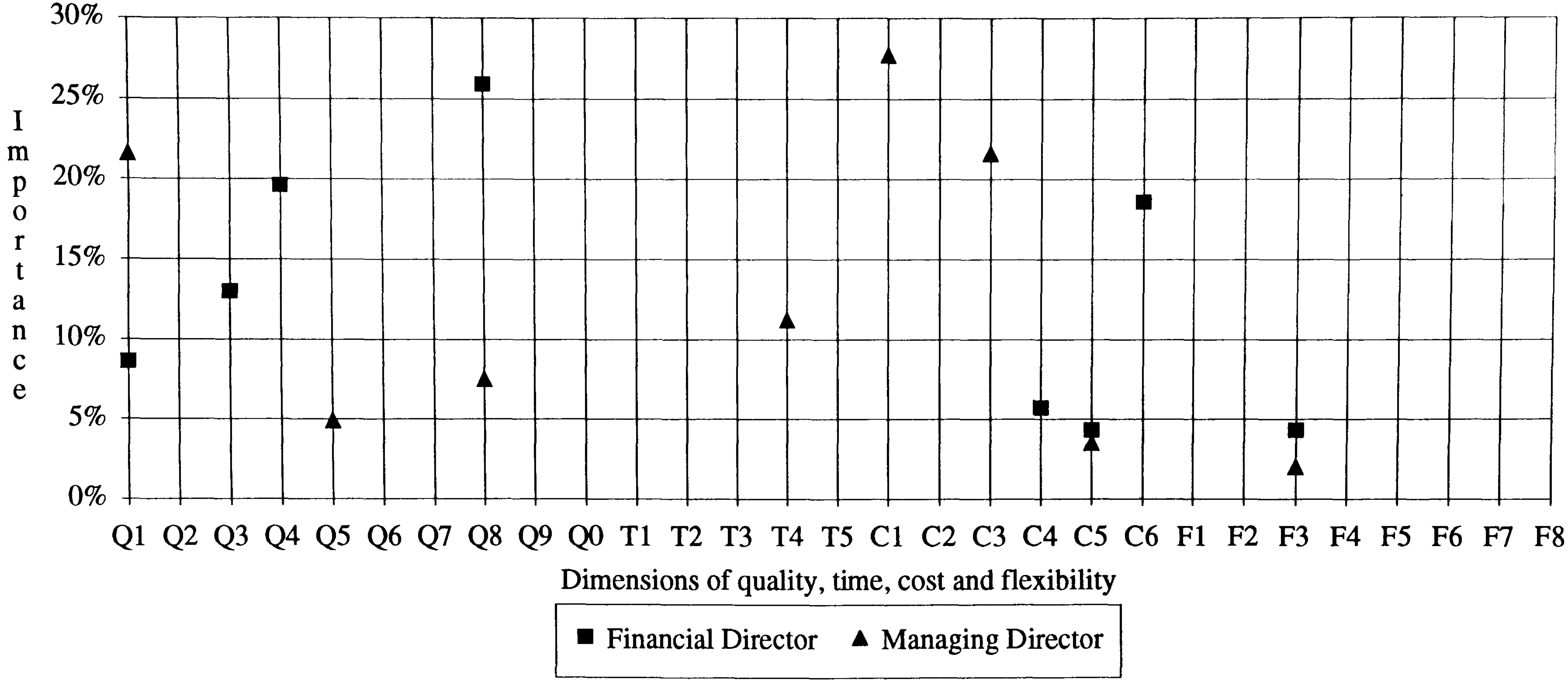
4.5.1: **Through the organisation's hierarchy**

The first pilot study was conducted in company A which manufacturers coin-operated amusement games for the leisure industry. Company A has five main product families and each interviewee was asked to focus on the largest[13] of these - the AWP (amusement with prizes) product range - to minimise the risk of goal incongruence being caused by people adopting different perspectives (Hill, 1985; Skinner, 1974a; Wheelwright, 1978). Ten people were

12 The raw data are listed in Appendix III.

13 In terms of sales volume.

Figure 4.11: Sample interviewee profiles showing how the managing and financial directors of company B prioritised the factors that they identified as internally important



interviewed; the manufacturing and marketing directors, the production and development managers, the heads of two manufacturing departments, their respective foremen and two technical leading hands. Of the ten interviews, three were aborted. The first was abandoned because the development manager insisted on talking about his own function and was therefore unable to define the manufacturing task. The second was terminated because the technical leading hand concerned was only interested in criticising the firm. The third, involving the second technical leading hand, was not completed because, despite repeated probing, the consistency ratio generated during the pairwise comparison process remained extremely poor (greater than sixty percent)[14].

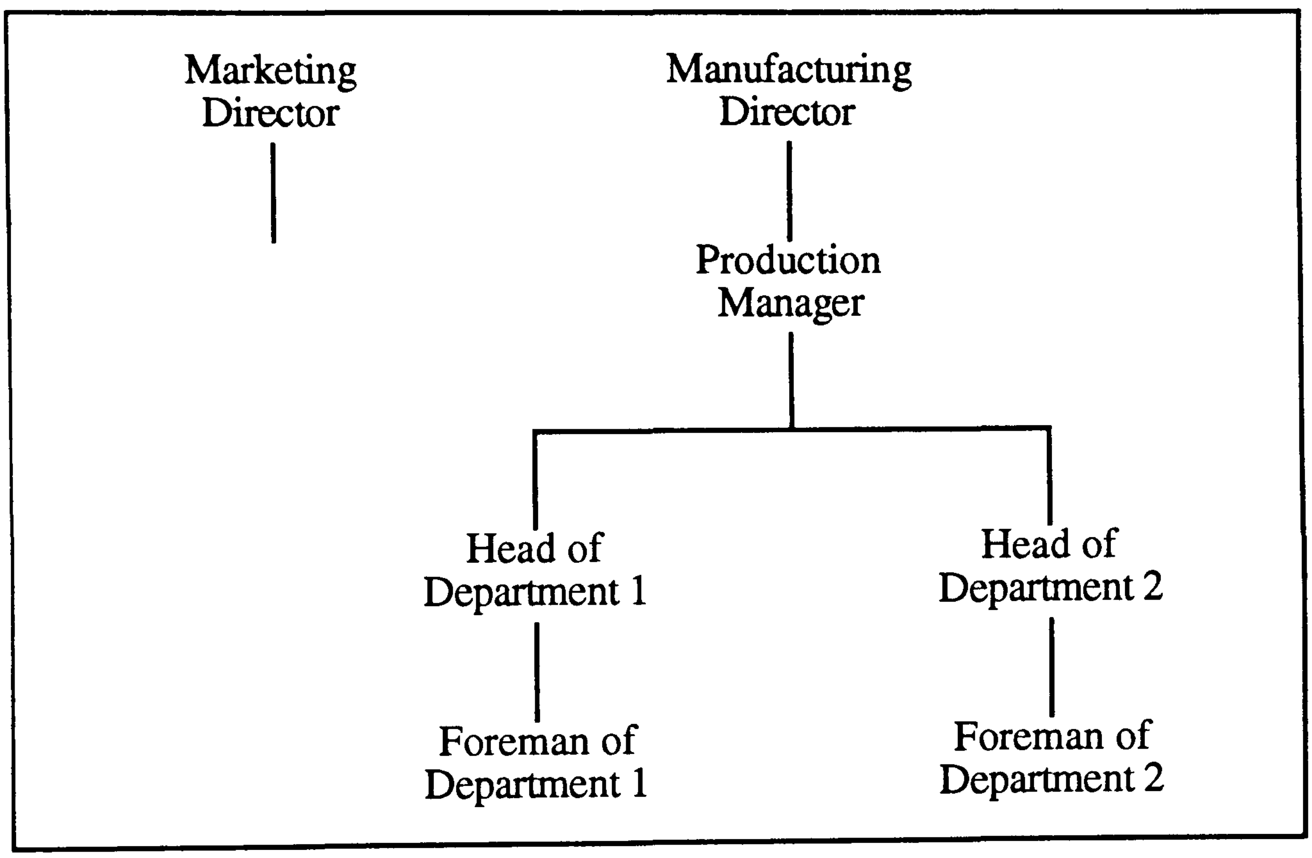
Figure 4.12 shows how the seven remaining interviewees were spread across four levels of the organisation's hierarchy. The fact that the interviews with the two technical leading hands had to be aborted suggests that people at lower levels in an organisation's hierarchy might find it difficult to contribute to the audit process. This observation is contradicted, however, by the fact that interviewees at all levels of this and other organisations were able to contribute to later studies (see section 4.5.3 and chapter 6).

Figure 4.13 shows those factors that were identified as internally important by the seven interviewees during the structured interviews. The data presented in figure 4.13 have not been modified in any way. That is, none of the interviewee definitions have been taken into account. The chart clearly shows the diversity of opinion that exists within the firm's manufacturing function. Take, for example, product performance quality (factor Q1). Both the marketing and manufacturing directors believe that this is the most internally important factor. The production manager, on the other hand, does not even include it in his list. One could argue that this is because the production manager contributes to product performance quality by ensuring that products conform to the design specification (factor Q4) and hence he is likely to believe

[14] Saaty (1980) suggests that if the consistency ratio is greater than ten per cent then there is a risk of rank reversal - that is, there is a danger that the actual ranking of the factors may be incorrect. Hence in the case of the aborted interview either the author had failed to explain the pairwise comparison process adequately or the interviewee was not co-operating.

that factor Q4, rather than Q1, is one of the most important. Figure 4.13, however, negates this argument as it shows that the production manager does not include conformance to specification in his list of the eight most internally important factors. Hence it seems safe to assume that there is a lack of goal congruence between the directors and the production manager with regard to, among other things, product performance quality.

Figure 4.12: Interviewees who contributed to the first pilot study



The alternative method of data comparison suggested in section 4.4 involves examining what factors were identified as important, rather than how they had been prioritised. Figure 4.14 shows those factors that were identified as internally important by more than half the interviewees. Taken together, figures 4.13 and 4.14 highlight an interesting dichotomy. Figure 4.13 suggests that there is a wide variety of opinion within the firm as to what constitutes the manufacturing task. Figure 4.14, however, shows that it is widely recognised that delivery on time (T4), manufacturing cost (C1), and the ability to change the mix of resources used (F8) are of fundamental importance. Hence there appears to be an underlying goal congruence which is partially obscured by figure 4.13. These two sets of data suggest that the goal incongruence that exists across the hierarchy of company A is not a function of the definition of

Figure 4.13: Interviewee profiles showing how the factors that were identified as internally important in company A were prioritised by the different interviewees

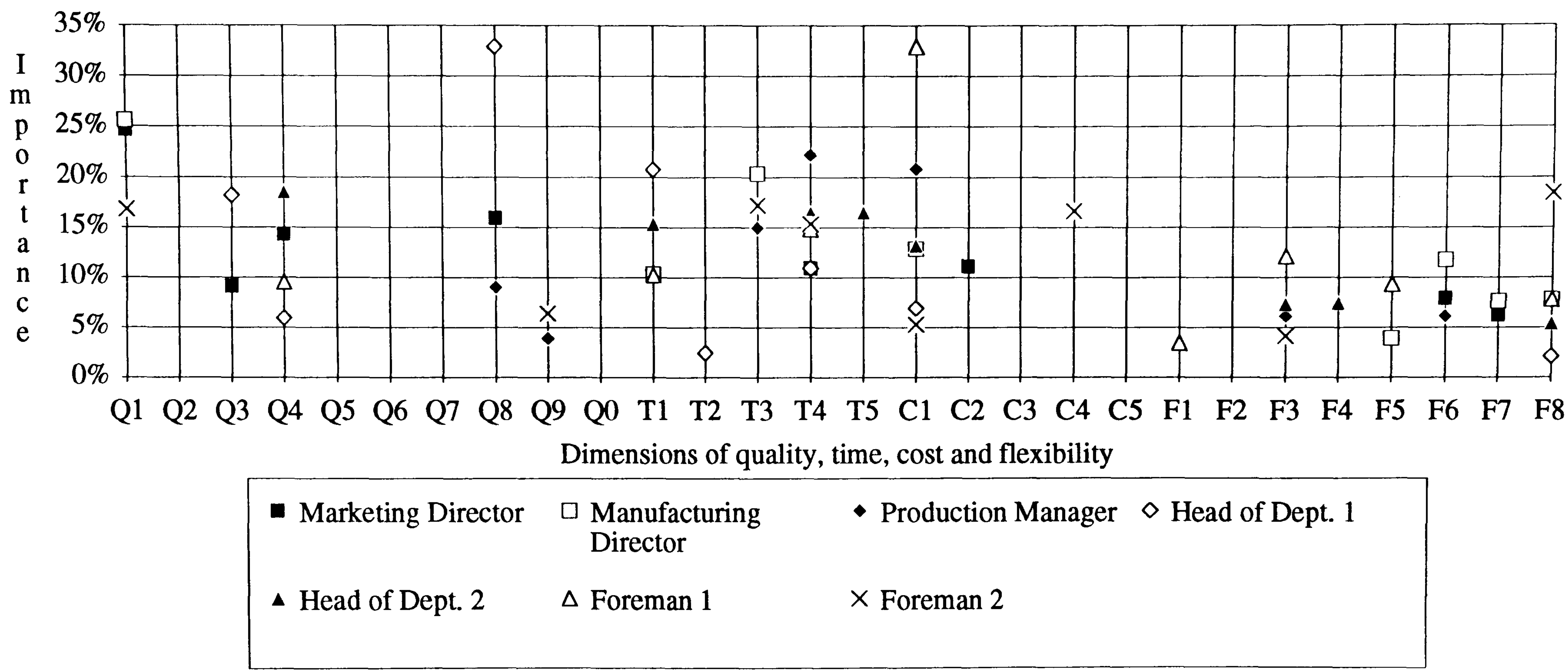
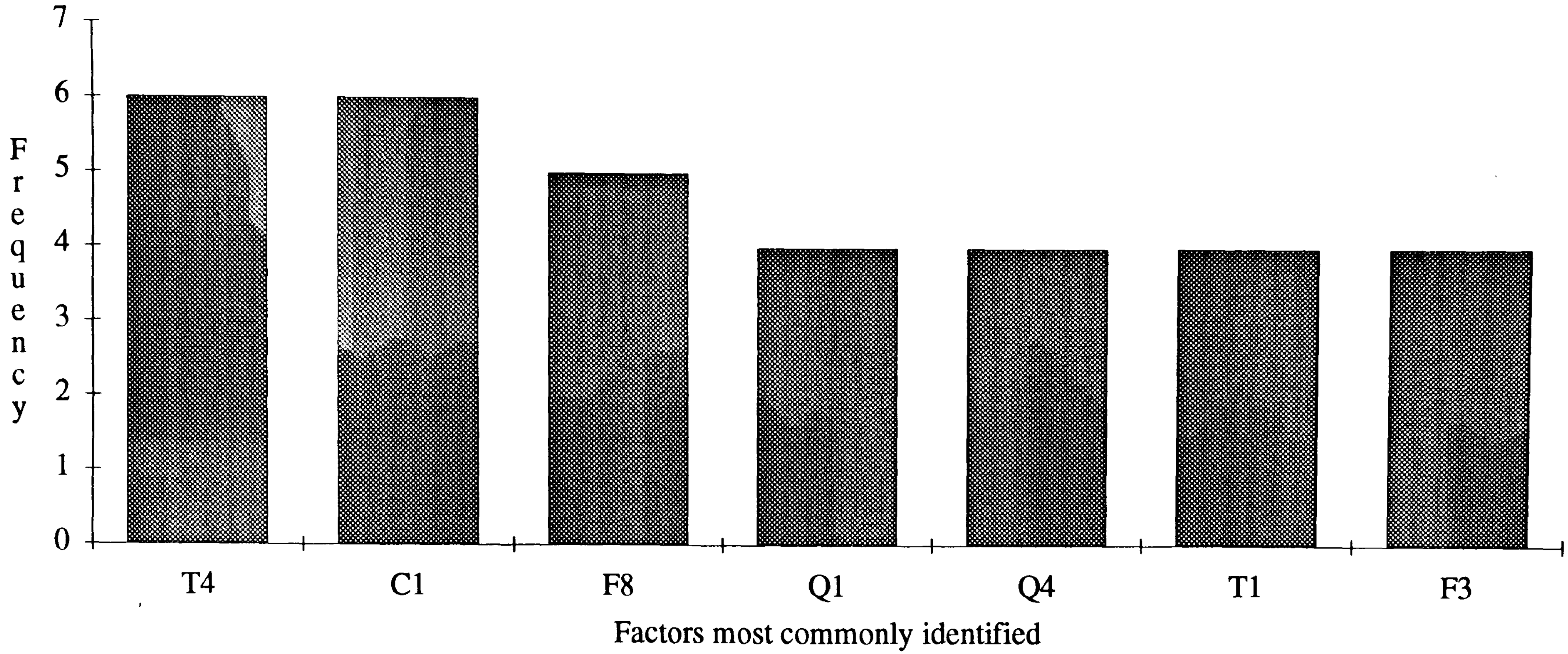


Figure 4.14: Factors identified as internally important by more than half of the people interviewed in company A



the manufacturing task, but of the prioritisation of its elements. That is, the important elements of the manufacturing task are widely understood, but the way in which they are prioritised is not.

Further complexity is added to the analysis when the interviewee's definitions are taken into account. Figures 4.15 and 4.16 illustrate this. Figure 4.15 shows those factors that were identified as externally important by more than half of the interviewees, but ignores their definitions. Figure 4.16, on the other hand, takes account of these and, as can be seen, shows that three rather than two factors are recognised as externally important by more than two thirds of the sample. This suggests there is a slightly higher level of agreement (goal congruence) about the externally important elements of the manufacturing task than indicated by figure 4.15. These data reinforce the importance of having precise definitions for each of the factors.

4.5.2: Across the organisation's functions[15]

The second pilot study took place in company B, which designs and manufactures special purpose machine tools for the automotive industry. It has two main product lines - traditional and advanced machine tools. This study focused on the traditional machine tool business. All five company directors were interviewed and none of them experienced any difficulty defining the internal and external dimensions of the manufacturing task. This suggests that, despite the problems encountered with the development manager of company A, the structured data collection process described in section 4.3 can successfully be used with managers from functions other than manufacturing. Figures 4.17 and 4.18 show the interviewee profiles and the factors most frequently identified as externally important by the directors of company B. As in the first case the interviewee profiles (figure 4.17) highlight the lack of goal congruence in the organisation. Take, for example, the managing and financial director's profiles. Figure 4.17 shows that the managing director thinks that criterion C1, the manufacturing cost is the most important factor. However manufacturing

15 This section is based on Neely and Wilson (1992a).

Figure 4.15: Factors identified as externally important by more than half of the people interviewed in company A

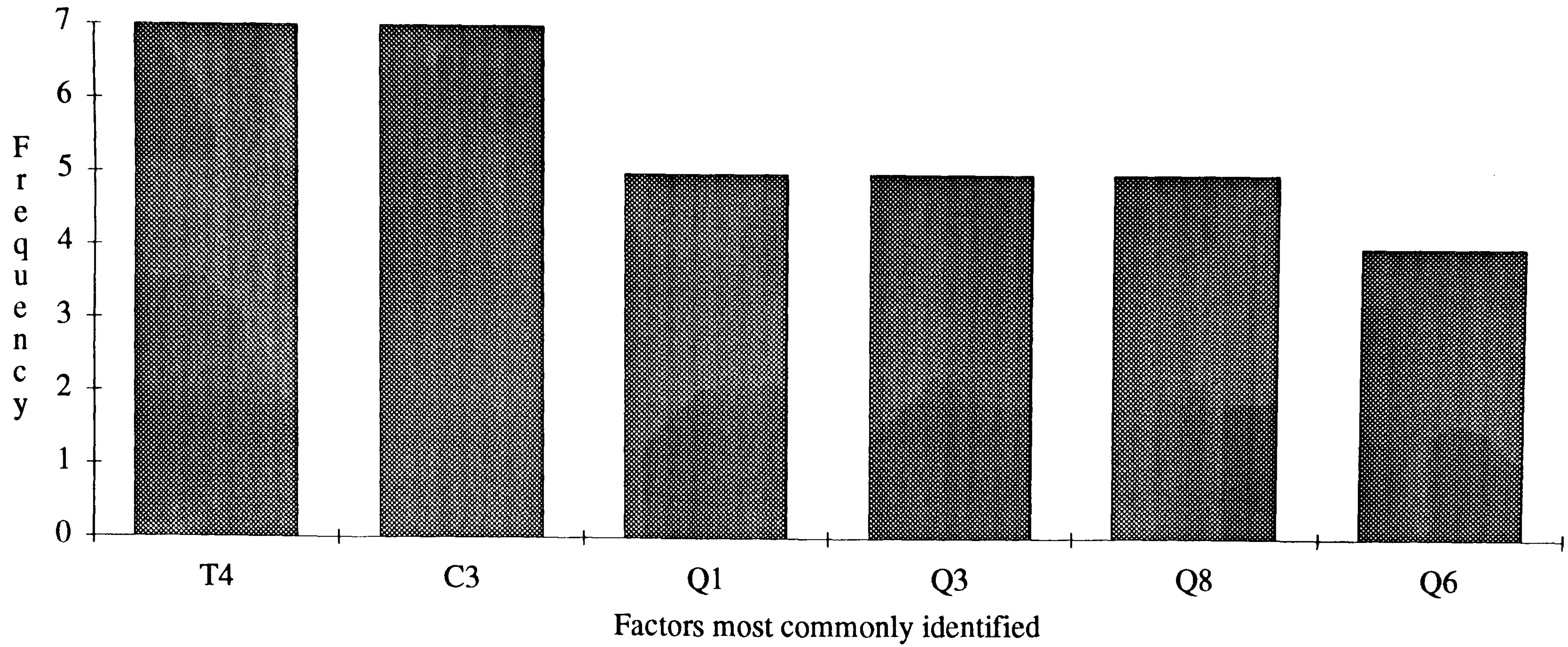


Figure 4.16: Factors identified as externally important by more than half of the people interviewed in company A taking the interviewee's definitions into account

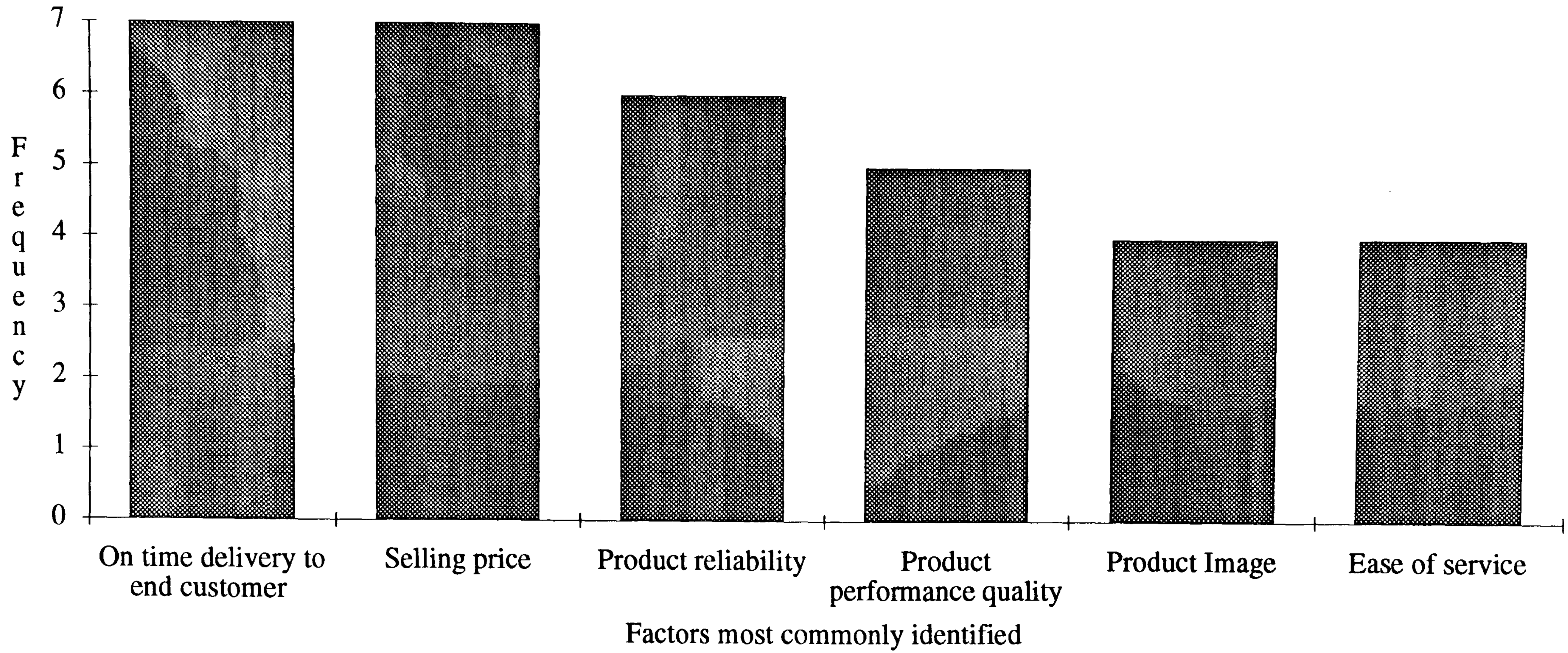


Figure 4.17: Factors identified as externally important by the directors of company B

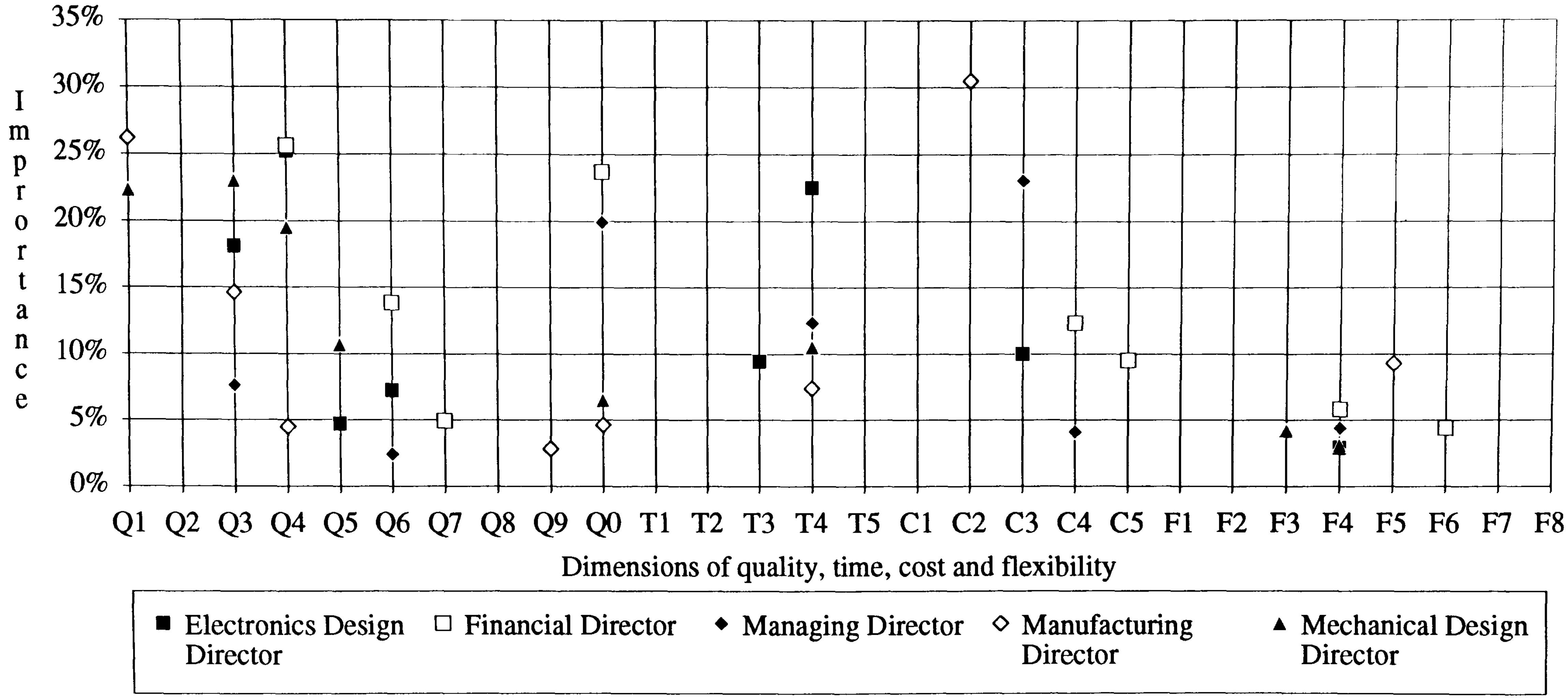
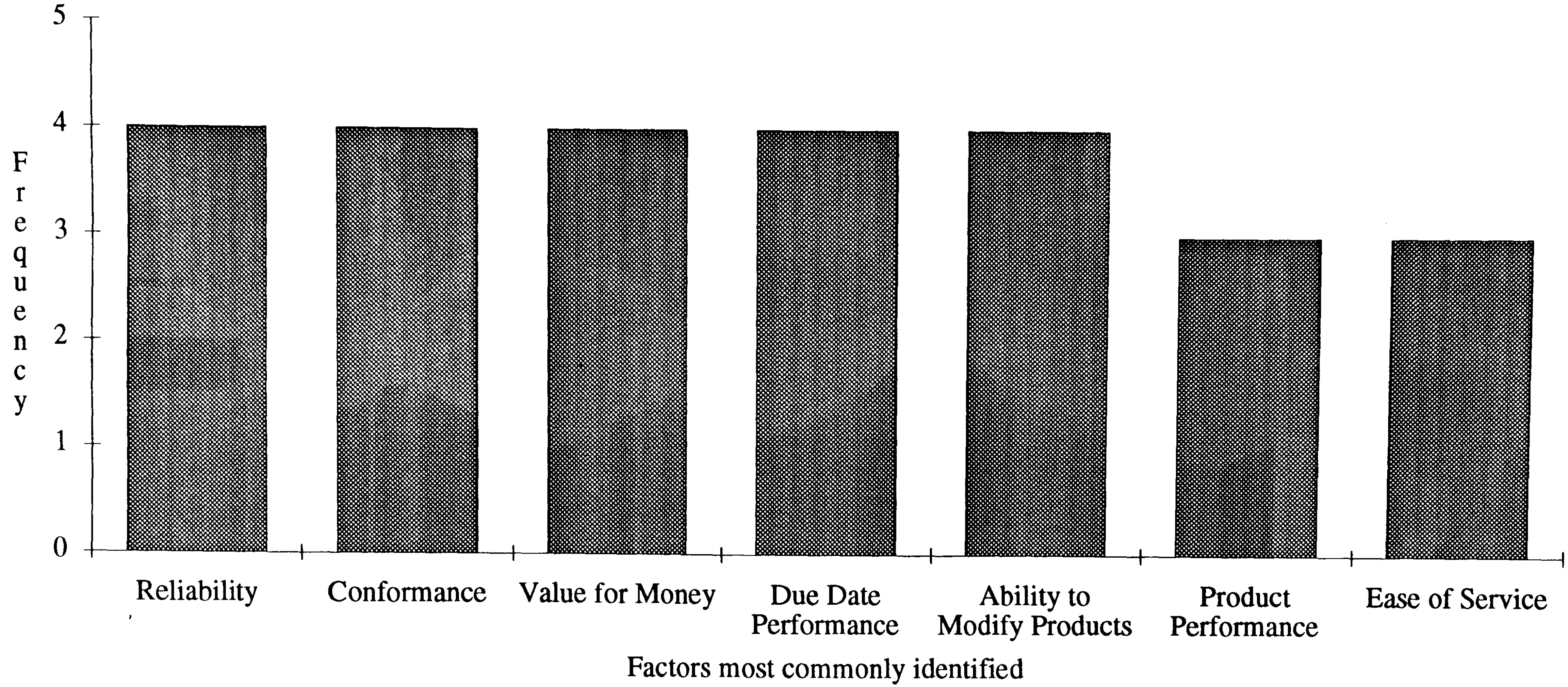


Figure 4.18: Factors identified as externally important by more than half of the directors of company B



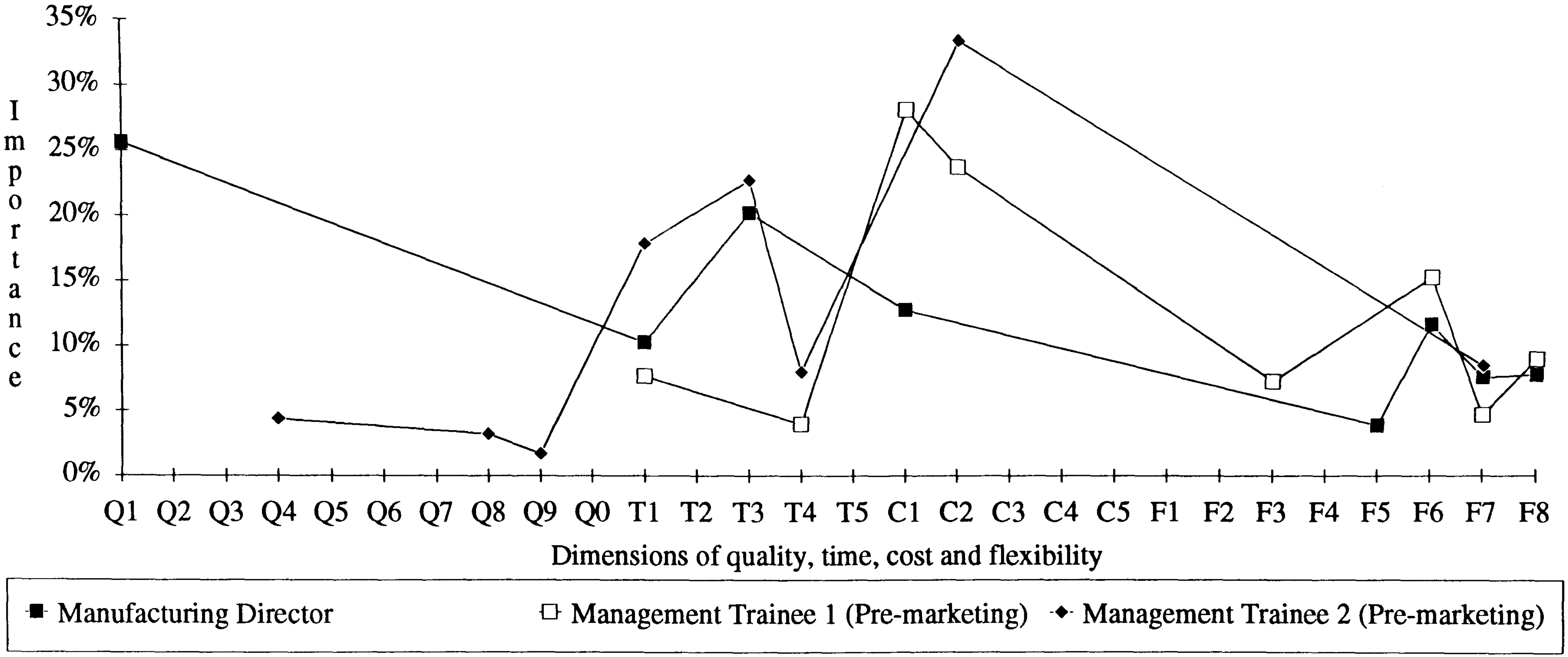
cost does not even appear on the financial director's profile, who feels that criterion Q8, perceived quality, is the most important. The managing director feels criterion C3, selling price, is the second most important factor, whereas the financial director suggests that it should be conformance to customer specification, which does not appear in the list of the managing director's top eight factors. (This may, of course, be because the managing director assumes that if his third most important factor, Q1, the product performance is acceptable then the product will conform to specification). For the financial director the third most important factor is profit. Again this is a factor which does not appear in the manufacturing director's top eight criteria. Hence it appears safe to assume that there is a lack of goal congruence even within the top management team of company B. Despite these observations, however, figure 4.18 suggests that, as before, the goal incongruence that can be observed is largely due to the prioritisation of the factors which constitute the manufacturing task and not their definition. That is, most people understand what the task is. They do not, however, concur on how important its various elements are.

4.5.3: **Over time**

The third pilot study took place in company A and involved a series of interviews with three technical leading hands over a period of six months. Two of the interviewees were on an internal management development course. This involved them spending three months in each of the firm's major functional departments. The third interviewee remained in the same job for the duration of the study and was used as a control. The purpose of this study was to examine the stability of an individual's perception of what is important over an extended period of time as it could be argued that one's perception of what is important will be coloured by recent local events, such as the return of a batch of defective product.

Figure 4.19 shows the interviewee profiles for the manufacturing director and the management trainees prior to them spending a period of time in marketing. Figure 4.20 shows the same profiles, but presents the data for the marketing

Figure 4.19: Interviewee profiles for the manufacturing director and the management trainees prior to the their time in marketing



director and the management trainees after their time in marketing. The greatest distinction can be observed in the changing profile of the first management trainee (see figure 4.21). Note that prior to joining the marketing department he stressed the internal importance of flexibility and had a profile which closely resembled that of the manufacturing director. After he left marketing, however, perception of what was important had changed and he placed far more emphasis on the quality related factors, as did the marketing director.

During the six months that this pilot study lasted the "control" was interviewed three times. On each occasion he was given the option of reselecting, redefining, and reprioritising those factors that he had identified as most important at the previous interview. Figure 4.22 shows how his perception of what was externally important changed during this period. It should be noted that the variances are only minor. Hence these limited data suggest that one's perception of what is important is relatively stable, even over an extended period of time, unless one is subject to a major stimulus, such as a change in department or organisational role.

4.6: Critique of the pilot process

As already discussed the pilot studies were designed to test the utility, validity and reliability of the pilot version of the goal congruence audit. In this context, utility refers to the usefulness of the process, reliability refers to the repeatability of the process, and validity refers to whether the process examines what it is meant to. In this section data gathered as a result of the author's participant observation, both during the audit process and whilst providing feedback to the companies involved, will be used to critique the pilot version of the goal congruence audit along these dimensions. This will involve addressing the following questions:

-Is the pilot version of the goal congruence audit a useful process?

-Is the pilot version of the goal congruence audit a reliable process?

-Is the pilot version of the goal congruence audit a valid process?

Figure 4.20: Interviewee profiles for the marketing director and the management trainees after their time in marketing

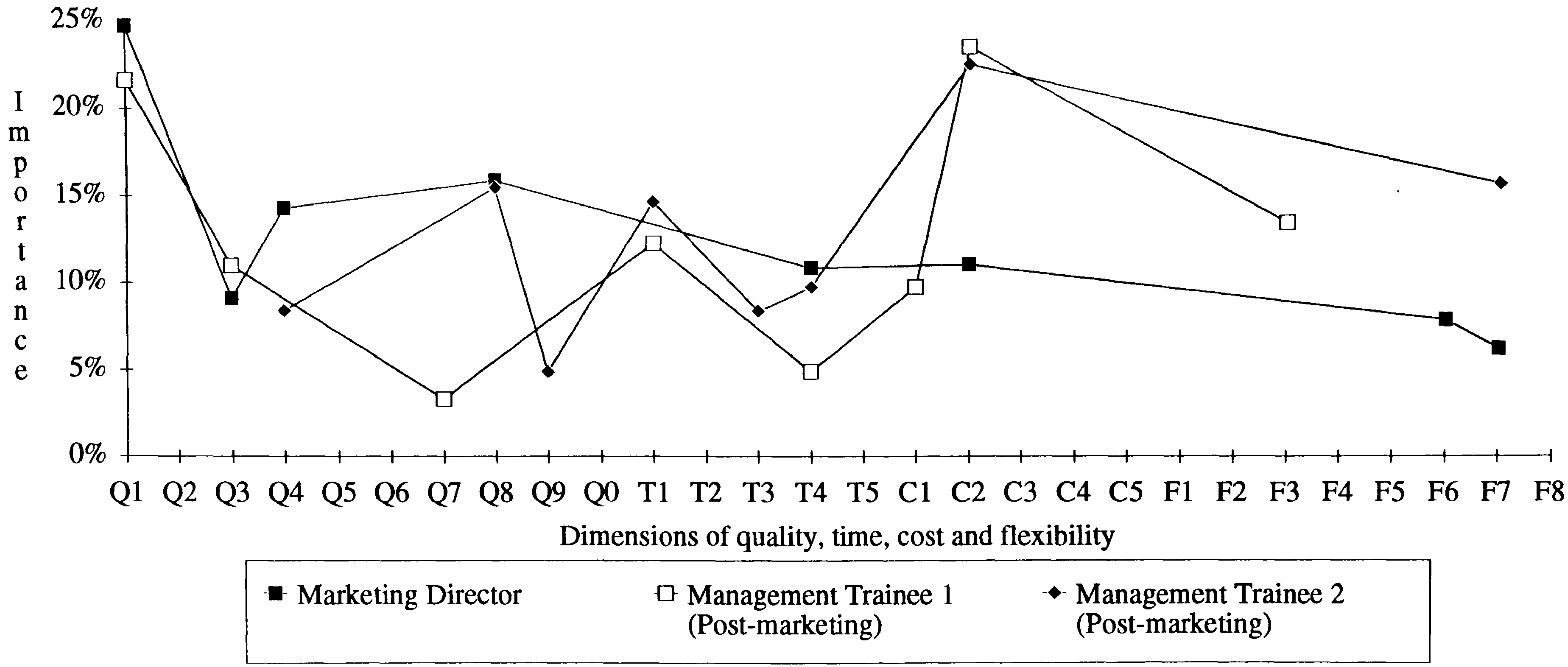


Figure 4.21: Interviewee profile showing how the perception of the first management trainee changed once he had joined the marketing function

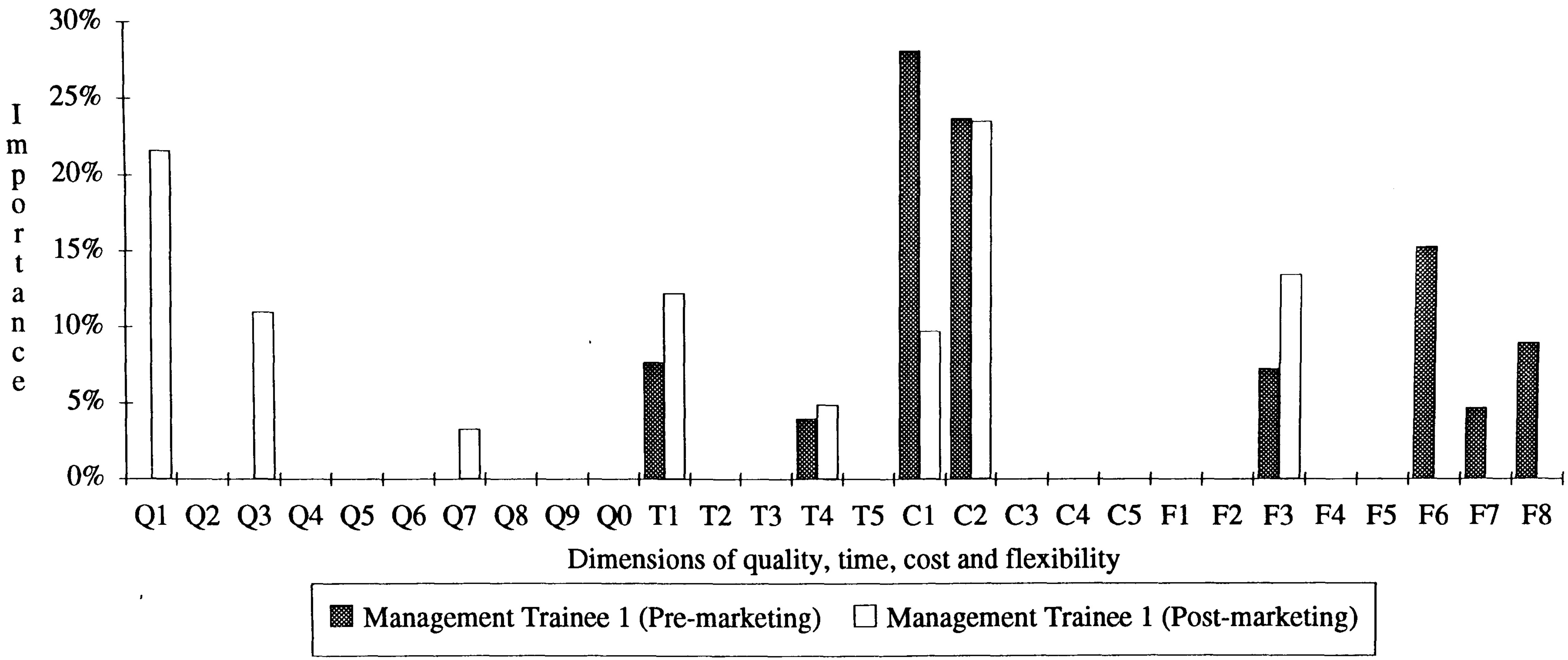
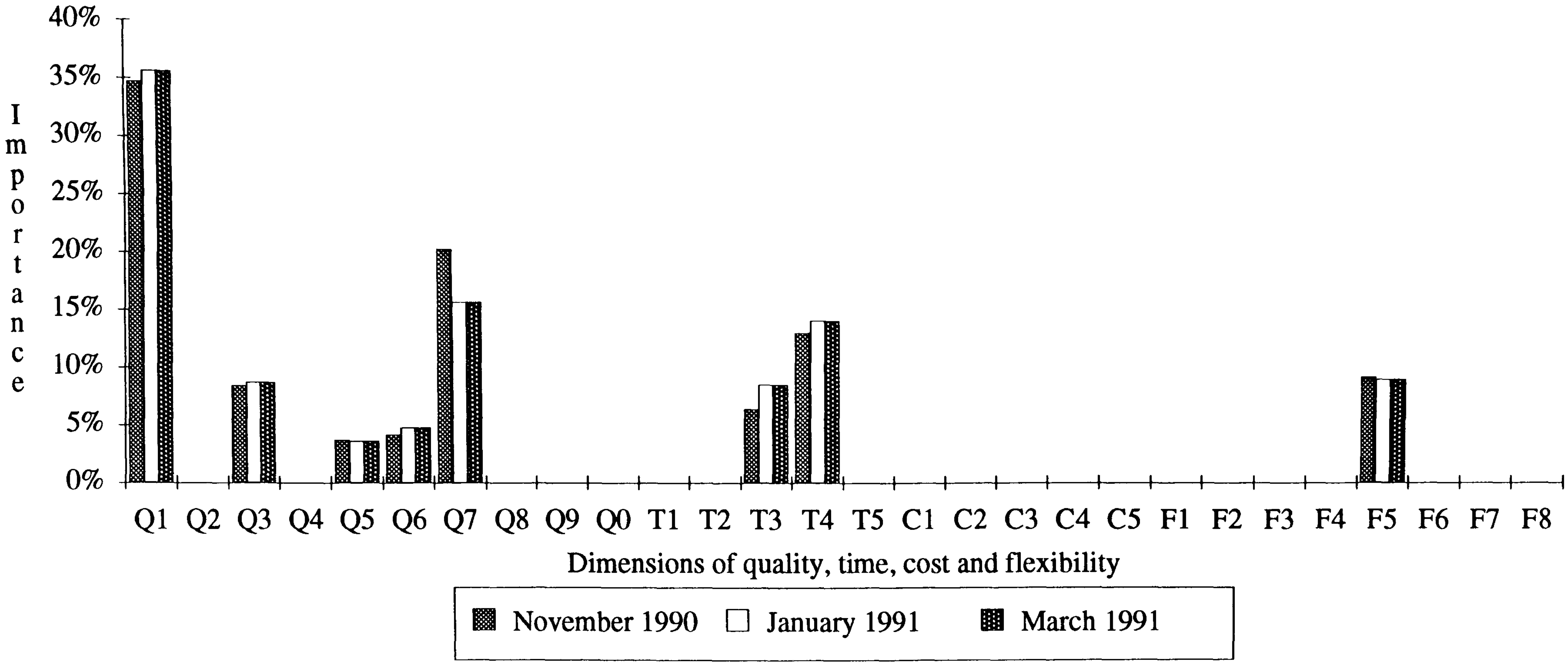


Figure 4.22: Interviewee profile showing how the perception of the "control" changed between November 1990 and March 1991



4.6.1: **Utility of the audit**

The pilot version of the goal congruence audit was designed to identify areas of goal incongruence as the literature implies that these will inhibit a firm's ability to realise its manufacturing strategy. Hence the utility of the audit is a function of whether it enables one to identify areas of goal incongruence efficiently and effectively. Figures 4.13 and 4.17 show that goal incongruence exists in both companies A and B. Figures 4.14 and 4.18, however, suggest that the goal incongruence that can be observed is a function of the prioritisation of the factors which together constitute the manufacturing task, rather than their identification and definition. Hence while the audit is effective it is not as efficient as it might be because the time each interviewee spends on the second stage of the data collection process - identifying and defining the factors - is largely wasted.

Of the eighteen interviews conducted as part of the pilot study, fifteen were completed. These included interviews with managers in different functions and employees from all level of the organisation's hierarchy. Hence the second point to note about the utility of the pilot version of the goal congruence audit is that it is easy to understand and use. This was later confirmed when a MSc student, working in conjunction with the author, used the author's methodology to audit the level of goal congruence in two Swedish companies (Aldrin, 1991).

4.6.2: **Reliability of the audit**

There are two potential sources of unreliability - the process itself and external influences. In terms of the data collection process the use of formal check sheets and pairwise comparisons minimises the risk of interviewer bias. While the structure of the questions, e.g. referring the interviewee back to their own definitions, minimises the risk of interviewee bias. As the data comparison processes are fixed, they are by definition repeatable. The most likely source of external influence is that recent organisational events may colour an interviewee's perception of what is important. The limited data gathered during the second of the pilot studies conducted in company A confirm this, but suggest that such changes in perception are most likely to occur if the events have a major impact.

4.6.3: **Validity of the audit**

The validity of the audit can be examined at two levels - the individual and the firm. At the level of the individual, the immediate analysis and feedback of the data is likely to enhance the validity of the data collection process, as will the use of the consistency ratio. Following each study the main findings were fed back to a senior management team and their accuracy was confirmed during the ensuing discussion. Hence it would appear that the data collected were valid.

4.6.4: **Enhancements to the audit**

The goal congruence audit described in sections 4.3 and 4.4, then, not only achieves its purpose, but also appears to be both valid and reliable. Having said this a number of ways of improving the audit were identified during the pilot studies and subsequent analyses. The first relates to the issue of what the term "important" means. During the pairwise comparison process the interviewees were asked to say which was more important factor A or factor B. Some of them responded to this question by asking whether they were meant to be identifying what they felt was important, or what they believed the firm's senior managers thought was important. This confusion emphasises the significance of the phrasing of the question. It should have been of the form; "which do **you** think is more important to the long run success of the firm - factor A or factor B".

The second point that emerged during the pilot studies was that the list of factors shown in figure 4.1 is not complete. When the definitions that the interviewees had provided were examined it became apparent that some of the terms in figure 4.1 could be applied to either the firm or it products. Reliability, for example, can be interpreted to mean reliability of the firm - does it always keep to the promises it has made, or reliability of the product - does it keep working as it should. Another problem was caused by the fact that some of the terms were already part of the company's language. In company A, for example, the term "features" was used in a design specific context and hence the majority of people interviewed in this firm saw features as an integral part of the product and not as "optional extras". A modified version of figure 4.1 is presented in figure 4.23. This shows all the different factors that were identified during the interviews. The fact that each interviewee was asked to define the factors that they had selected as most important increases the validity of the audit. Unfortunately it also lengthens the interviews and complicates the data comparison process, as each definition has to be examined before any comparisons can be made. It should be noted that the results of the pilot studies suggest that most of the goal incongruence that exists is due to the prioritisation of the factors rather than their identification and definition. Hence if each interviewee were given a pre-defined set of factors (the manufacturing missions) which together constituted the firm's manufacturing task and simply asked to prioritise them, the audit could be considerably simplified without losing either its validity or reliability. These themes will be taken up in chapter six when the integrated congruence audit is described.

Figure 4.23: The Dimensions of quality, time, cost and flexibility - revised

QUALITY

Product performance
Product features
Product reliability
Company reliability
Conformance
Technical durability
Technological durability
Serviceability
Aesthetics
Product image
Company image
Customer relations
Employee relations
Value for money

TIME

Manufacturing lead time
Rate of product introduction
Delivery lead time
Internal due-date performance
External due-date performance
Frequency of delivery

COST

Manufacturing cost
Value added
Selling price
Product running cost
Product service cost
Product warranty cost
Return on investment
Profit

FLEXIBILITY

-the ability to cope with

Variations in incoming materials
Variations in output product quality
New product introduction
Product modifications
Delivery demands
Volume demands
Product mix
Resource mix

4.7: **Summary**

In this chapter the first phase of this research, the development and testing of the goal congruence audit, has been documented. The chapter began by exploring some of the methodological issues associated with the identification of areas of goal incongruence. Then the two structured processes - data collection and data comparison - which together constitute the pilot version of the goal congruence audit were detailed. Next the results of three pilot studies were presented. These were used to examine the utility, validity and reliability of the audit; (a) through the organisation's hierarchy, (b) across its functions and (c) over time. Most of the goal incongruence observed was caused by disagreement regarding the prioritisation of the elements which make up the manufacturing task, rather than disagreement over their identification and definition. Hence it was concluded that the second stage of the data collection process could be eliminated thereby reducing the length of the structured interviews.

CHAPTER 5: THE SYSTEM CONGRUENCE AUDIT

CHAPTER 5: THE SYSTEM CONGRUENCE AUDIT

5.0: Introduction

In chapter 3 it was stated that a high level of system congruence could be said to exist in a firm if:

> **-The firm's goal setting, performance measurement, feedback and reward systems are used to induce decision making and action consistent with the manufacturing task.**

Hence auditing the level of system congruence in a firm involves examining the extent to which the firm's systems stimulate behaviour which is consistent with the manufacturing task. To do this the manufacturing task must be defined, the firm's systems identified, and the extent to which the systems encourage appropriate behaviour determined. The first step in this process - the definition of the manufacturing task - forms part of the integrated congruence audit described in chapter 6. Hence the system congruence audit itself consists of two stages; (a) identifying what the firm's systems are, and (b) determining whether they induce appropriate behaviour. This chapter describes the development and testing of the system congruence audit - the second phase of this research.

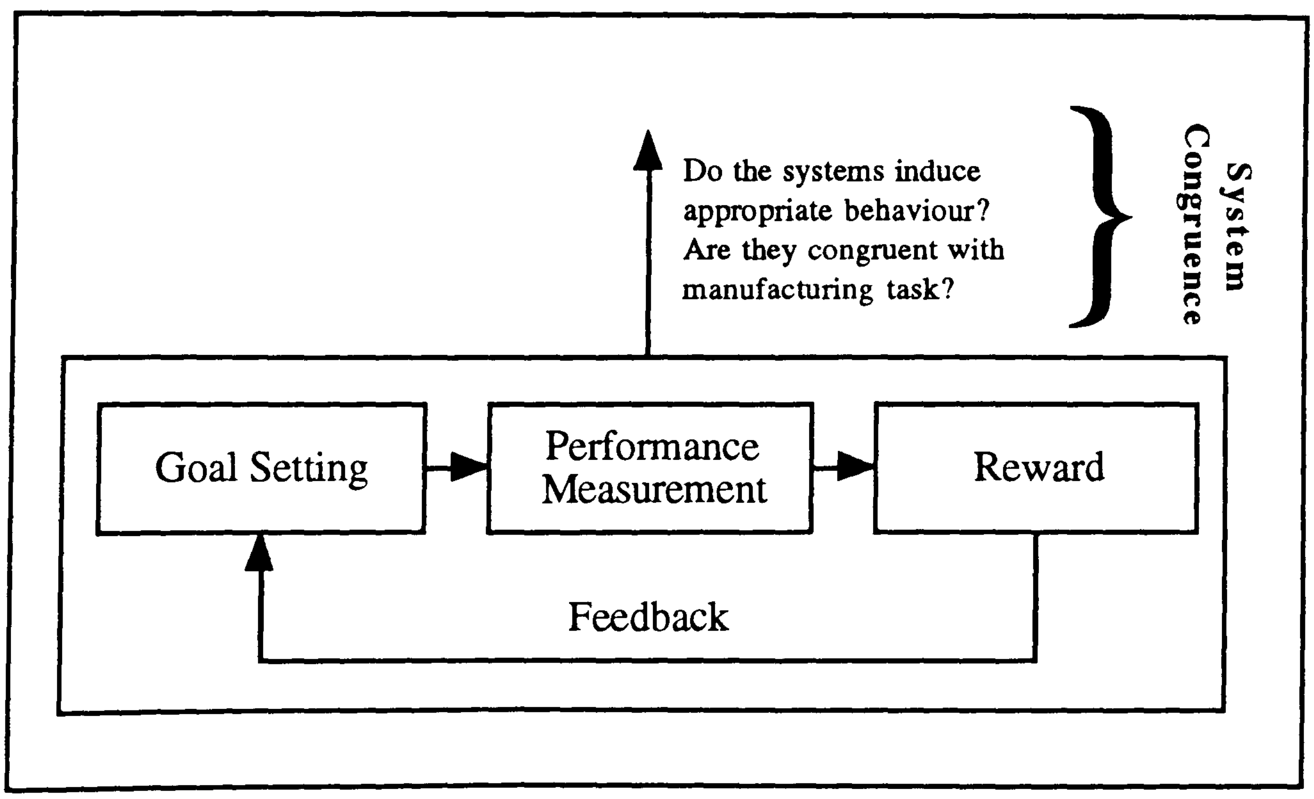
The remainder of the chapter has been split into four sections. In the first the theory underlying the concept of system congruence is briefly summarised. As much of this theory is drawn from the business strategy and organisational behaviour literature it was deemed necessary to test its applicability to the manufacturing environment. This was done through a shadowing study in one firm and a series of semi-structured interviews with managers from fourteen others. The results of these studies will be presented in section two. In section three the pilot version of the system congruence audit will be described and its testing documented. The audit was tested during two structured interviews in company C. The minor modifications to the audit that this resulted in are discussed at the end of section three. The chapter will be summarised in section four.

5.1: **Theoretical foundations**

The literature review presented in chapter 2 contained a number of implicit and explicit references to the notion of system congruence. In the section on business strategy, for example, the concept of strategic control - using a firm's goal setting, performance measurement, feedback and reward systems to induce decision making and action consistent with its strategy - was introduced. Similarly in the section on organisational behaviour the notions of management control and performance management were discussed.

Figure 5.1, which is drawn directly from figure 3.1, pictorially represents what is meant by system congruence in the context of this thesis. As has already been made apparent, however, the notion of system congruence is largely based on the work of organisational behaviourists, such as Child (1985), and business strategists, such as Bungay and Goold (1991), Hrebiniak and Joyce (1984) and Lorange et al. (1986).

Figure 5.1: System congruence in the context of this thesis



In the more specialist manufacturing strategy and operations management literature the focus appears to be more uni-dimensional (Neely, 1993b; Neely et al., 1993). Azzone et al. (1991), for example, assert that companies which seek to employ time based competition should use the set of generic measures shown in table 5.1, but fail to mention that these measures have to be integrated with the wider strategic control system. Similarly Crawford and Cox (1990) present guidelines for developing performance measures appropriate for a Just-In-Time manufacturing environment, but fail to acknowledge that the measures have to match the wider organisational infrastructure.

Table 5.1: Measures for time-based competition (Azzone et al., 1991)

	Internal Configuration	External Configuration
R&D Engineering time	Number of changes in projects Δ average time between subsequent innovations	Development time for new products
Operations Throughput time	Adherence to due dates Incoming quality Distance travelled Value-added time (% of total time) Schedule attainment	Outgoing quality Manufacturing cost
Sales and marketing Order processing lead time	Complexity of procedures Size of batches of information	Cycle time Bid time

Perhaps the most extreme example is provided by the work of Dixon, Nanni and Vollmann (1990). Despite the fact that they recognise that:

"If a company has a strategic objective of achieving better quality, it is not only necessary to have action programmes that support quality, but the score-keeping system in manufacturing must also connect to both the strategy and the actions. Performance measures must appraise, reinforce, and reward improvements in quality in the terms of the action programmes being used to pursue quality" (Dixon, Nanni and Vollmann, 1990, 7).

They fail to include any reference to the firm's goal setting, feedback or reward systems in the subsequent development of their performance measurement questionnaire.

There are a host of possible reasons why the manufacturing and operations management research community has focussed on the performance measurement system as the primary means of inducing behaviour consistent with the manufacturing task and failed to acknowledge the importance of the wider strategic control system. One such reason is that performance measurement has received a massive amount of publicity through the work of authors such as Kaplan (Johnson and Kaplan, 1987; Kaplan, 1982, 1983, 1984a, 1984b, 1986, 1988, 1990). Hence it is natural that performance measurement is uppermost in many researcher's minds. There is, however, another possible explanation which, if correct, would have great implications for this thesis. For while a strategic control system might be the appropriate mechanism for inducing consistency of decision making and action at the higher levels of an organisation, it may be inappropriate for the manufacturing function. That is, perhaps manufacturing managers really do use the performance measurement system as the primary means of inducing decision making and action consistent with the manufacturing task. For this reason it was decided that prior to the development of the system congruence audit the author should seek to identify which systems manufacturing managers really do use to influence the behaviour of their subordinates. Basically the research question that was being addressed in this sub-study was:

-Is the model shown in figure 5.1 applicable to the manufacturing function?

5.2: Testing the model[16]

There were two phases to this investigation. In the first, five managers from company A were shadowed for one working week and the stimuli they received recorded on a check sheet of the format shown in figure 5.2. In the second, managers from a further fourteen companies in both the U.K. and Japan were interviewed and asked about the operationalisation of the model. The data collected during both of these phases will be presented and discussed in this section.

5.2.1: Shadowing study

The shadowing exercise followed the piloting of the goal congruence audit described in section 4.5.1 and sought to address, through direct observation, the question of whether the model shown in figure 5.1 accurately reflects the strategic control process used in the manufacturing function of company A. During a week long investigation the production manager, the heads of two manufacturing departments, and their respective foremen were all shadowed for up to one working day. As far as possible the author collected data on the stimuli that these managers both sent and received using a check sheet of the format shown in figure 5.2. The full set of data, along with the author's diary, are presented in Appendix IV. The following comments are a distillation of both these data and the author's observations.

During the shadowing exercise it became apparent that company A's manufacturing function was driven by the production schedule. The vast majority of stimuli both sent and received by the managers shadowed concerned progress to schedule. The production manager visited the five main manufacturing departments every morning and asked where production was versus the schedule. He even asked for the progress of one department to be formally monitored and displayed on a white board. During the course of each day progress to schedule was discussed during numerous phone conversations and at various face-to-face meetings. On a weekly basis all managers were

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16 This section is based on Neely and Wilson (1992b and e).

Figure 5.2: Example of the check sheet used for data collection during the shadowing exercise

Time	Stimulus	Sent/Received	Factor	Media	Comments
8.30am	Tour of factory	From production	Internal &	Face-to-face	
	Consistent message - where	manager, to heads of	external		
	are we versus the plan	department and foremen	delivery		
10.35 - 10.36	I can't do that job. The	From foreman to production	Internal &	Face-to-face	
	components are not here.	manager	external		
			delivery		
	We must have fifty by	From production manager	Internal &	Face-to-face	
	the end of today.	to foreman	external		
			delivery		
10.40-10.43	When will the components	From production manager	External	Phone	
	be available? They were	to purchasing manager	delivery to		
	due in at 4.00pm yesterday.		company		

expected to forecast what level of manning they would need if they were to meet the following week's schedule.

In terms of the model, then, the managers in company A were set goals relating to delivery on time (the weekly production schedule) and their performance was measured, albeit informally, by the production manager. While this undoubtedly focussed attention on working to schedule (figure 4.14 showed that six of the seven managers interviewed identified delivery on time as an internally important factor, while figure 4.16 showed that all seven of them believed that on time delivery to the end customer was externally important) the performance measures tended to be used in a negative way. That is, the production manager, the heads of the manufacturing departments and their foremen would not be asked by their supervisors and peers if they were behind schedule, but how far behind they were. The phrasing of the question implied that every one knew that the manager concerned always failed to meet the schedule. As a result of this "negative" measurement the heads of two of the manufacturing departments said that they thought they were likely to loose their jobs in the near future. A feeling reinforced by the manufacturing director when he put all the managers on one month's notice because the firm was failing to meet its delivery schedules efficiently.

In the manufacturing function of company A, then, the control system which relates to the manufacturing mission[17] - "we must ensure that we deliver on time" - can be seen to consist of; goal setting (the schedule), performance measurement (informal and negative), feedback (meetings with the production manager and manufacturing director) and sanction (threat of redundancy). No financial rewards were linked directly to the department's performance with regard to whether it met the weekly production schedule. Non-financial incentives, such as promotion, may have been. If they were, however, none of the managers shadowed appeared to have been aware of it.

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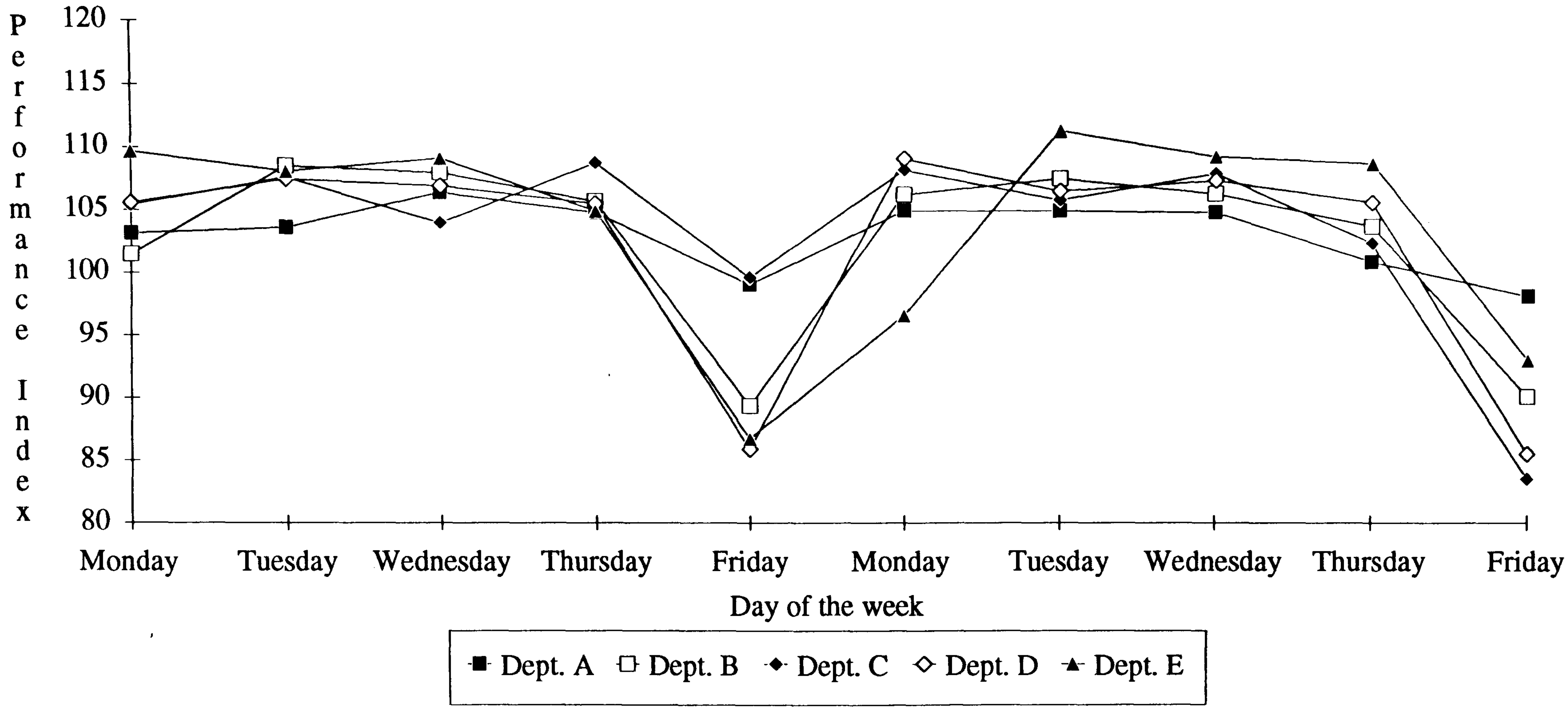
17 The term manufacturing mission is used in this thesis to refer to the individual elements or factors which together constitute the manufacturing task.

The second factor that was widely identified as internally important in company A was manufacturing cost (see figure 4.14). The importance of controlling the firm's costs was emphasised through the formal performance measurement system. This was based on traditional measures of efficiency such as; labour efficiency, percentage of time spent setting and percentage of time waiting for work. Many of the problems usually associated with such a system could be observed (Johnson and Kaplan, 1987; Hall et al., 1991). The head of one of the manufacturing departments, for example, explained how he ignored the schedule and just produced standard components in large batches to minimise the time his staff "wasted" setting up machines. The head of another said that as repair of defective parts was classified as non-productive work, he would often rectify defects himself so that his department's efficiency did not suffer.

Financial incentives were also used to emphasise the importance of controlling manufacturing costs. Everyone in the firm was eligible for an annual bonus based on cost effective sales - a function of unit costs and the number of units sold. In addition the operatives were paid an individual incentive. Each job was a assigned a standard time by a work study engineer. An operative working at the standard rate, performance index (PI) 100, would be expected to complete the job in the standard time. Operatives that worked faster were paid a higher rate with no limit being applied to individual jobs. Payment for the week, however, was capped at 105PI. Hence the operatives could maximise their income by working at an average of 105PI for the entire week. If they worked any faster they would not benefit from any extra income and if they worked any slower their income would be reduced. Figure 5.3 shows the average PIs achieved in the five main manufacturing departments for a two week period in June 1991. Note how the payment system is self-regulatory. The operatives tend to work harder at the beginning of the week and then relax on Friday. Effectively they were managing the payment system so that their income was maximised, while the effort they had to exert was minimised.

Returning to the model shown in figure 5.1, then, the importance of controlling

Figure 5.3: Average performance indices in company A's main manufacturing departments



manufacturing costs was reinforced in company A through goal setting (target efficiency levels for departments and operatives), performance measurement (data on standard hours are formally collected), feedback (via various internal reports and the bonus systems), and reward (annual and weekly bonus payments). It should be noted that not all these systems actually do what they were designed to do. Take the departmental efficiency targets, for example. As discussed earlier, these encouraged the head of one department to rectify defective products himself. The control system not only made him do things that really should have been delegated and hence reduced the amount of time he spent on his real role, but also meant that he sent a signal to his subordinates which effectively said - producing defective product is acceptable in this department.

5.2.2: **Follow-up study**

Two main conclusions can be drawn from the shadowing study. The first is that the model shown in figure 5.1 accurately reflects the control processes used in company A to reinforce the importance of two elements of the manufacturing task - delivery on time and control manufacturing costs. The second is that despite careful design control systems can stimulate undesirable behaviour. The objective of the follow-up study was to investigate how widely these findings apply. To do this semi-structured interviews were conducted with managers from fourteen different companies in both the U.K. and Japan, the actual sample being determined largely by ease of access[18]. Figure 5.4 shows a copy of the letter that was sent to each of the Japanese companies prior to the author's visit. Similar letters were also sent to all the U.K. firms. The questions contained in the letter formed the basis of each semi-structured interview. In the remainder of this section the data collected during these interviews will be documented and discussed.

18 The visits in Japan were arranged by Professor Katayama of Waseda University and Professor Nagamachi of Hiroshima University. Although this imposed some constraints on the sample, it was still possible to visit firms from a variety of industrial sectors.

Figure 5.4: Copy of the letter sent to the Japanese companies

THE INSTITUTE FOR OCCUPATIONAL ERGONOMICS

University of Nottingham
Dept of Production Engineering
and Production Management
University Park
Nottingham
NG7 2RD

2nd July 1991

To whom it may concern

<u>Study Tour in Japan</u>

I am writing to ask if it would be possible for me to visit your organisation when I visit Japan this autumn. I am currently working for the Institute of Occupational Ergonomics which is part of the Department of Manufacturing Engineering and Operations Management at the University of Nottingham. I am particularly interested in the communication of organisational goals and objectives and how the attainment of these is influenced by the following four systems.

1. The goal and target setting process.
2. The monitoring (performance measurement) system.
3. The feedback (reports, meetings, face-to-face contacts) processes.
4. The reward (payment, recognition) criteria.

An ideal plant visit, from my point of view, would have the following format:

1. **Discussion with senior manager(s)**

Typical questions would include:

-what is the organisation's strategy?
-can you define your competitive advantage in terms of quality, time, cost and flexibility?
-how do you define your competitive edge?
-to what extent do the employees in the company understand the importance of the factors which form the basis of your competitive edge?
-do you want to increase the level of their understanding?
-if so, then how will you do this?

Figure 5.4 (continued): Copy of the letter sent to the Japanese companies

To whom it may concern 2 2nd July 1991

2. **Plant tour**

Typical questions would include:

-size and age of plant.
-number of employees, percent of direct and indirect staff.
-performance of plant (inventory turns, market share, sales/employee, profit/employee).
-quality standards (defect levels, scrap rates, methods used to improve quality).
-time based competition (delivery lead times, due-date performance, rate of product introduction).
-cost of operation (inventory levels, value added, return on investment).
-ability to cope with changing customer demands (set-up reduction, product mix, batch sizes).

3. **Discussion with a group of employees**

Typical questions would include:

-what do you think the organisations goals are?
-how do you define quality, time, cost and flexibility?
-how are your goals set?
-how is your performance monitored?
-what feedback do you receive?
-what reward systems are used in this organisation?

I am currently writing a PhD thesis and feel that visiting a number of world class Japanese companies will add a great deal to my research. I hope your organisation will be able to help me and I look forward to meeting you when I come to Japan.

Yours faithfully,

A. D. Neely

Table 5.2 summarises the data collected during each of the fourteen[19] site visits. The sample of interviewees within each firm varied from one to eight managers and although the data are only cursory, and not directly comparable because of the difference in sizes of the firms, they raise some interesting issues. At the outset of the follow-up study it was believed that all the firm's systems - goal setting, performance measurement, feedback and reward - should be designed so that they are congruent with the manufacturing task. This is not only what company A had tried to do, but also consistent with the business strategy and organisational behaviour literature. By the end of the follow-up study, however, the author had begun to question whether it was possible to adopt what could be called a **neutral reward system**; that is, a reward system which is not linked directly to the manufacturing task. This change in attitude was prompted by two things. First many of the managers interviewed in the U.K. companies reported that the reward systems used in their firms were inappropriate and often inhibited change. Figure 5.3 shows how company A's individual incentive scheme limits productivity. The production manager of company 4 explained how the introduction of new and more competitive working practices had been rejected by both the production engineers and designers as they believed it would reduce their productivity and hence their pay in the short term. In company 3 an individual incentive scheme was still being operated even though it conflicted with the team based manufacturing philosophy that had been adopted. When asked why this was the case, the personnel manager replied; "because our supervisors could not manage without the incentive scheme".

The second thing that prompted the author's change in attitude was seeing a number of firms which were successfully operating neutral reward systems (companies 1, 5, 8, 9, 10 and 13). In all the Japanese firms visited salary was a function of past performance, seniority and age (which because of the practice of lifetime employment is equivalent to length of service). Past performance

19 The visits to company's 11 and 14 did not produce much data. In the first case the management team were not particularly open. In the second the author's contact had been taken ill and hence there had been little preparation prior to the visit.

Table 5.2: Data gathered during the follow-up study

Company	1
Date of interview	20/8/91
Products	Cars
Location	U.K., but a Japanese transplant.
Number of employees	3000
Manufacturing task	"As a company we aim to build profitably the highest quality car sold in Europe", through people and team working. Quality is a function of aesthetics, reliability and technical durability.
Goal setting systems observed and discussed	Daily output target displayed on a neon screen above each production line. Total cost reduction action (TCRA) for indirect staff. General objectives are cascaded down through the organisation. Specific targets are set as a result of discussion/negotiation.
Performance measurement systems observed and discussed	Extensive use of benchmarking among sister plants. The firm has a standard Vehicle Evaluation System to ensure comparability of data.
Feedback systems observed and discussed	Extensive use of wall charts, including ones that presented data on safety, skills matrices, benchmarks of press productivity and company 1's 1991 zero defect campaign. Morning meetings where supervisors update the incoming shift regarding recent quality problems. Plant director's biannual address.
Reward systems observed and discussed	If production targets are achieved before the end of a shift everyone stops work and goes on a training course. Payment is based on standard scales and annual appraisal. No company or individual incentive schemes are operated.

Table 5.2 (continued): Data gathered during the follow-up study

Company	2
Date of interview	22/8/91
Products	Automotive components
Location	U.K.
Number of employees	400
Manufacturing task	Minimise costs. Conform to customer's specification. Offer a short lead time and reliable deliveries. Selling price is an issue, but not as important as the above four items.
Goal setting systems observed and discussed	Company 2 is owned by a well known U.K. holding company. The senior management team are set tight financial targets. These are fed down to the shop floor in the form of efficiency and output targets.
Performance measurement systems observed and discussed	Every operator has to fill in a job card. This is the basis for his/her bonus. The focus is on speed of work.
Feedback systems observed and discussed	The firm used to have monthly feedback sessions where the line was stopped. These have now been replaced by a newsletter which usually contains something on current production levels and the state of the market. Last month's newsletter also had a report on company 2's recent safety record.
Reward systems observed and discussed	Company 2 has adopted a cellular layout and hence uses a group based incentive scheme. Bonuses are paid to all the members of a cell on a weekly basis. The actual payment is a function of standard hours earnt by the cell.

Table 5.2 (continued): Data gathered during the follow-up study

Company	3
Date of interview	28/8/91
Products	Tools for the drilling and mining industries
Location	U.K.
Number of employees	400
Manufacturing task	Product performance, delivery reliability and selling price are all important to the customer. Profit (and hence costs) are the key drivers internally.
Goal setting systems observed and discussed	Primary goal setting system for manufacturing is the production schedule - see later.
Performance measurement systems observed and discussed	The production manager uses adherence to schedule (delivery performance) and value of arrears (cost/profit) to monitor his subordinates performance.
Feedback systems observed and discussed	The production manager identified the weekly production meetings and face-to-face discussions as the primary means of feedback. He said that in both cases he would focus on adherence to schedule and value of arrears.
Reward systems observed and discussed	Company 3 operates an individual incentive scheme. Payment is based on standard hours earnt and capped at 130 PI. As with company 2 the focus was on speed of production.

Table 5.2 (continued): Data gathered during the follow-up study

Company	4
Date of interviews	19/8/91 and 28/8/91
Products	Punches, engraved dies and marking machinery
Location	U.K.
Number of employees	250
Manufacturing task	Delivery lead time, delivery reliability and longevity of the die are the key concerns of the customer. Low cost is the internal driver.
Goal setting systems observed and discussed	Two main goal setting systems are used by the production manager of company 4 - the first is the annual appraisal, the second is the weekly production meeting. At the appraisal the appraisee's targets for the next year are set. Typically these would be things like achieve a cost saving of 10%. At the production meeting high value, late orders are usually discussed.
Performance measurement systems observed and discussed	The production manager plots charts of % of orders delivered on time. He would like to monitor other dimensions of performance, such as lead times, but the necessary data are unavailable. All supervisors are issued reports which show their departments PI.
Feedback systems observed and discussed	Little feedback other than through the weekly production meeting. Some posters on the firm's suggestion scheme although this appears to have fallen into disrepute.
Reward systems observed and discussed	Individual or group incentive based on output versus standard times. Small (10%) allowance for quality.

Table 5.2 (continued): Data gathered during the follow-up study

Company	5
Date of interviews	24/9/91
Products	Communications and audio systems
Location	Japan
Number of employees	1600
Manufacturing task	Delight/surprise the customer by providing middle of the price range products which are easy to us and technologically advanced.
Goal setting systems observed and discussed	President's vision fed down through a "creative management system". Everyone is expected to continually seek creative ways in which they can improve their performance, or their department's performance, in line with the president's vision of the firm's future (kaizen). Note - kaizen is not dõzen (natural). It has to be encouraged. This includes target setting.
Performance measurement systems observed and discussed	Little data on performance measurement available. Each department was, however, set a target of two suggestions/employee/period. Achievement of this was formally monitored and displayed on a wall chart.
Feedback systems observed and discussed	Wall charts used to feed back data on performance. See comments above.
Reward systems observed and discussed	Basic salary is flat rate, but a biannual bonus based on company profitability is also paid. Managers encouraged to award a special discretionary bonus if someone is particularly creative. Payment is also made for all suggestions received. A token payment of 100 yen (£0.40) is made for poor ones.

Table 5.2 (continued): Data gathered during the follow-up study

Company	6
Date of interviews	25/9/91
Products	Heavy machine tools industry
Location	Japan
Number of employees	2025
Manufacturing task	Provide safe products which perform well, are easy to use and offer good value for money. In the past the focus has been on quality, cost and delivery. In the future it will be on quality, price, delivery and furnishing (customisation).
Goal setting systems observed and discussed	President's vision communicated via annual briefing. Everyone is then expected to develop their own action plan, including numerical targets, for the coming twelve months. These have to be approved by the employees superior.
Performance measurement systems observed and discussed	Performance versus targets is reviewed biannually by the president, four times a year by the vice-presidents and monthly by the department heads. Each target has a general heading and then sub-headings. Hence the different reviews deal with different levels of aggregation of performance data.
Feedback systems observed and discussed	Feedback is provided during two sets of meetings involving three levels of management. The president, vice-presidents and department heads meet biannually. The department heads, section heads and supervisors meet more frequently.
Reward systems observed and discussed	Basic salary is flat rate, but a biannual bonus based on company profitability and individual performance is also paid. Individual performance is assessed during performance appraisals, which focus on how well the employee has met his personal targets derived from the breakdown of the president's vision.

Table 5.2 (continued): Data gathered during the follow-up study

Company	7
Date of interviews	26/9/91
Products	Cars
Location	Japan
Number of employees	800 in the factory I visited, ~28,000 in total
Manufacturing task	"Develop cars and trucks of striking originality and value. They will be even safer vehicles, more protective of both people and the earth's environment".
Goal setting systems observed and discussed	Company personnel administration system used to evaluate and assess employee performance. Linked into job classifications based on skill requirements, the business plan and organisational climate.
Performance measurement systems observed and discussed	Performance evaluation is conducted biannually via an appraisal system. There are two types of appraisal - performance and attitude. The performance appraisals deal with past performance, targets for next six months and other issues, e.g. training required. The attitude appraisal deals with service record.
Feedback systems observed and discussed	Feedback provided on an ongoing basis and also during the biannual appraisals.
Reward systems observed and discussed	Basic salary is flat rate, but allowances are provided for dependents, overtime, position in the hierarchy, special duties (summer/winter allowance), commuting and miscellaneous items. Also a biannual bonus is paid. This is based on company and individual performance, as assessed during the appraisal.

Table 5.2 (continued): Data gathered during the follow-up study

Company	8
Date of interviews	30/9/91
Products	Electric motors
Location	Japan
Number of employees	Not available
Manufacturing task	Reliability and performance are the most important external dimensions, while cost reduction and efficiency are the most important internally.
Goal setting systems observed and discussed	Target 30 - the plant will be thirty years old soon, so the slogan target 30 has been coined to encourage everyone to seek ways in which 30% improvements in customer satisfaction, efficiency and cost can be achieved. These three dimensions are translated into specific targets via the top-down, bottom-up strategic planning process known as hoshin kanri.
Performance measurement systems observed and discussed	Annually the directors of each plant meet and review progress towards their targets. Department and section heads are responsible for monitoring performance and providing feedback on it more frequently.
Feedback systems observed and discussed	Feedback on performance provided via morning meetings, newsletters, visual wall charts and leaflets/posters. Company 8 also identified priorities for certain periods. The priority for October and November of 1991, for example, had been identified as customer satisfaction.
Reward systems observed and discussed	Basic salary is flat rate, but a biannual bonus depending on company performance is paid. Most improvement activities are undertaken by quality circles and a token payment is made to each member of the team.

Table 5.2 (continued): Data gathered during the follow-up study

Company	9
Date of interviews	1/10/91
Products	Photographic film
Location	Japan
Number of employees	5,000
Manufacturing task	Reliability of product is of paramount importance to the customers. Efficiency is the principal internal driver.
Goal setting systems observed and discussed	Corporate planning department develops a plan based on last years sales, competitor actions and predicted market growths. The plan is presented to the company's president who, in turn, presents it to the site directors. As the plan passes down through the hierarchy, detail is added and targets are set. The targets are then aggregated and fed back up the hierarchy.
Performance measurement systems observed and discussed	Product quality is largely determined by the manufacturing process. Hence the targets and performance measures focus on cost reduction. Two indices are used to measure performance - a corporate and an individual index. The former is a function of sales, profit, yield and productivity.
Feedback systems observed and discussed	Meetings between the department and section heads to discuss performance take place monthly. All operators are responsible for feeding back data on equipment performance to their section head on a daily basis. Performance appraisals are also used. These provide a forum for feeding back information to individuals on their performance.
Reward systems observed and discussed	Basic salary is flat rate, but it is increased biannually. The first increase is related to an individual's performance. The second is a function of their length of service. The ratio of increase is 30:100, i.e. far more emphasis is placed on length of service than on individual performance.

Table 5.2 (continued): Data gathered during the follow-up study

Company	10
Date of interviews	2/10/91
Products	Oil refining
Location	Japan
Number of employees	300
Manufacturing task	Quality and delivery are controlled by the process. Hence the key driver, both internally and externally is cost.
Goal setting systems observed and discussed	Top level objectives for 1991 defined as; safe and stable operation - no injury, equipment downtime or pollution, effective plant operation - lowest cost and highest efficiency and manning management - maximise labour utilisation. These are fed down through the organisation. Even manufacturing engineers make weekly plans showing how their actions will contribute.
Performance measurement systems observed and discussed	All employees develop their own plans showing how they are going to contribute to the company's goals (e.g. I'm going to spend one day next week identifying and implementing a cost saving scheme). At the end of the week each employ is responsible for reviewing his/her progress versus his/her plan.
Feedback systems observed and discussed	Employees not only review their plans, but also feed the information back to their supervisors. Once a month each section head will call all his subordinates together and review the group's progress. The plant's progress is reviewed in the same way on a biannual basis.
Reward systems observed and discussed	Basic salary is flat rate, but biannual company bonus is paid. Payments are also made for suggestions. These vary from 100,000 yen (£400) to 5,000 yen (20).

Table 5.2 (continued): Data gathered during the follow-up study

Company	11
Date of interviews	3/10/91
Products	Glass
Location	Japan
Number of employees	2000
Manufacturing task	Quality a function of the manufacturing process. President's vision of the future is that the firm should seek to be more flexible, i.e. reduce batch sizes and lead times, while maintaining/reducing the cost base.
Goal setting systems observed and discussed	President's vision of the future reiterated every six months. Targets set as this "vision" is disaggregated and fed down through the organisation.
Performance measurement systems observed and discussed	Not discussed.
Feedback systems observed and discussed	Not discussed.
Reward systems observed and discussed	Not discussed.

Table 5.2 (continued): Data gathered during the follow-up study

Company	12
Date of interviews	7/10/91
Products	Videos
Location	Japan
Number of employees	1000
Manufacturing task	Produce "high-quality, high-performance products that meet the needs of our customers".
Goal setting systems observed and discussed	Company 12 asks its employees to document their own personal challenge plans. In these an employee is expected to write down his/her annual targets and discuss them with his/her section chief. Typically the targets relate to daily jobs and how they will contribute the achievement of sectional/departmental targets.
Performance measurement systems observed and discussed	Individual performance is evaluated through two systems, one for promotion and one for wages. Promotion is based on; ability, personality, future or predicted ability and motivation. Wages are based upon actual performance in the previous period.
Feedback systems observed and discussed	Feedback provided via wall charts, instruction sheets above each work station and output targets at the end of the production line. Typically the wall charts would start by defining the company's objectives and then explain how specific improvement activities were directed toward them. Morning meetings were also used.
Reward systems observed and discussed	Basic salary is flat rate, but pay rises are related to individual performance and contribution to the company's goals. Payments are also made for suggestions. These vary from 150,000 yen (£600) to 200 yen (£0.80).

Table 5.2 (continued): Data gathered during the follow-up study

Company	13
Date of interviews	8/10/91
Products	Batteries
Location	Japan
Number of employees	2000
Manufacturing task	Product performance, delivery reliability and selling price are the principal external drivers. Profit, satisfaction of employees, care for the environment and the local community were identified as internally important.
Goal setting systems observed and discussed	The firm has a long term plan (the company philosophy), a medium term plan (a five year horizon) and a short term plan (a one year horizon). Each of these plans are broken down into divisional, departmental and sectional targets. As one progresses down the hierarchy the abstractness of the targets decreases.
Performance measurement systems observed and discussed	Individual performance is evaluated annually according to; past performance, degree of speciality (knowledge, judgment, creativity, personal skills and leadership ability), loyalty and improvements activities undertaken.
Feedback systems observed and discussed	Feedback is provided through morning and evening meetings, visual displays on the shop floor. The company also operates a self-analysis scheme. Each employee has to rate their own performance over the previous year versus; quantity of work done and quality of work done.
Reward systems observed and discussed	Basic salary is flat rate, but a function of the most recent employee evaluation, position in the hierarchy and length of service. The company also pays a biannual bonus. Typically this amounts to between four and six months extra salary. The actual amount paid is dependent on company performance.

Table 5.2 (continued): Data gathered during the follow-up study

Company	14
Date of interviews	9/10/91
Products	Air conditioning units
Location	Japan
Number of employees	2000
Manufacturing task	Not discussed.
Goal setting systems observed and discussed	Company has an eternal philosophy (trust, think ahead and open atmosphere) and an annual one. Both philosophies are reiterated by the president annually and fed down through the company as goal are set.
Performance measurement systems observed and discussed	Not discussed.
Feedback systems observed and discussed	Not discussed.
Reward systems observed and discussed	Not discussed.

was determined through biannual appraisals which focussed on issues such as loyalty and attitude, as well as the quality and quantity of work done. All employees were also eligible for a biannual bonus, the size of which depended on the firm's performance. Typically this bonus amounted to between an extra four and six months salary per annum. Hence payment in Japan is largely a function of the firm's performance as a whole and is only superficially linked to specific dimensions of strategy. It should be noted that this is not entirely a cultural phenomena. Two of the firms visited in the U.K., companies 1 and D[20], operated neutral reward systems, although neither of them paid a biannual bonus.

Leaving aside reward, the firms visited used their goal setting, performance measurement and feedback systems to reinforce the importance of the manufacturing task in a variety of ways. Many of the Japanese companies, for example, operated a goal setting system known as hoshin kanri or strategy deployment (Akao, 1991). Short term targets for the organisation were derived from the annual financial objectives and the president's vision of the future. These targets were updated every six months and announced by the president at the start of the hoshin kanri planning process. The head of each plant would then ask his subordinates to explain how they thought their department could contribute to the attainment of the president's targets. In turn, the heads of department would ask the heads of the various sections how they believed their section could contribute. The first phase of the hoshin kanri process, then, involved the top-down devolution of a broad policy framework. In the second phase targets were defined at the lowest organisational levels. These targets then bubbled back up through the hierarchy so that the firm's president finally got an aggregated set of goals that everyone had helped to develop. This top-down/bottom-up chaining process is designed to ensure that everyone understands what the business is trying to achieve. It is shown graphically in figure 5.5.

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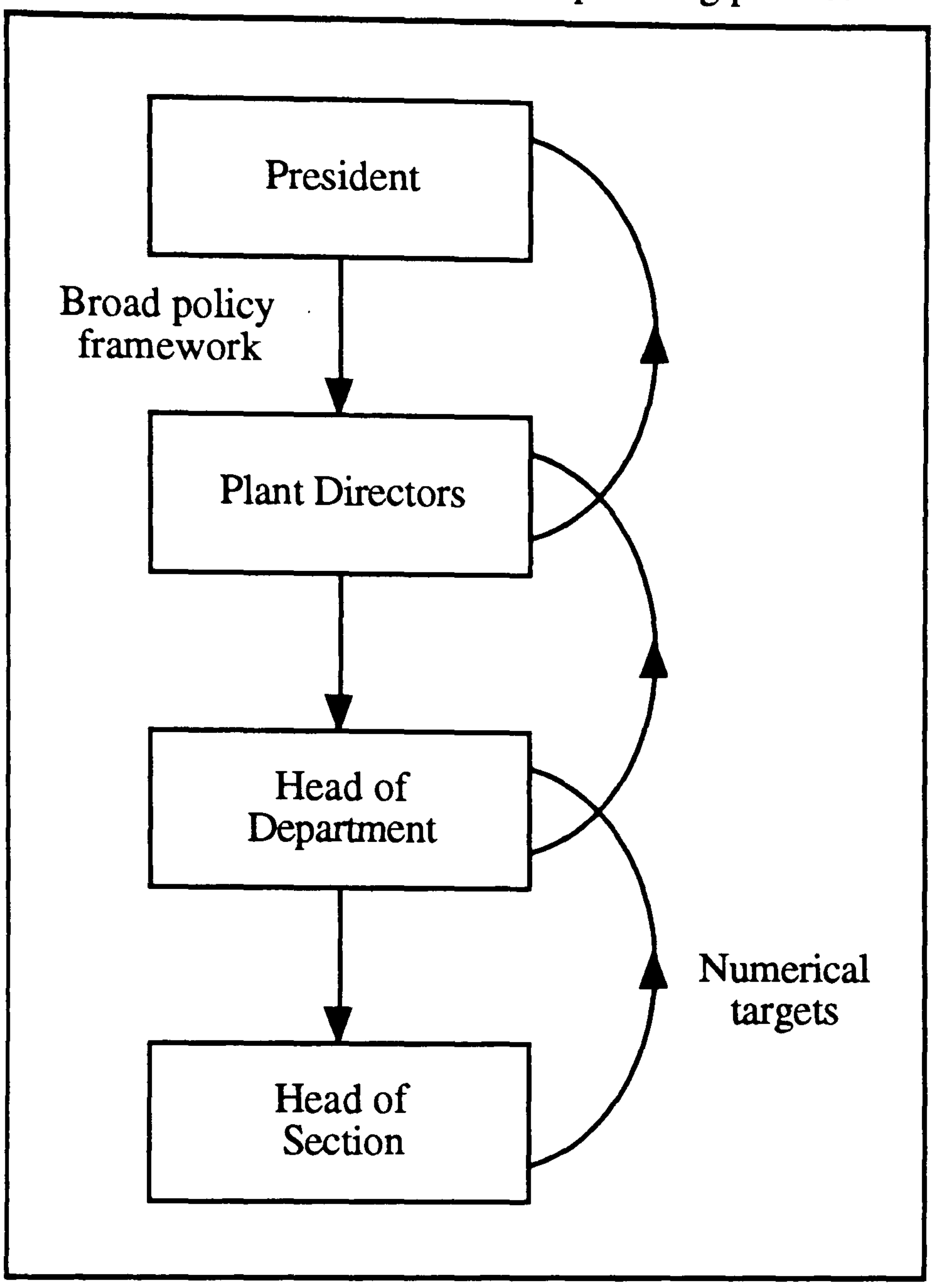
20 See chapter 6.

Figure 5.5: The hoshin kanri planning process



Other ways of influencing behaviour through goal setting were also identified. The production manager of company 4, for example, used the weekly production meetings to set explicit short term goals for his subordinates. For the first three weeks of every month the production manager would draw up an agenda which only featured those jobs which were behind schedule. The message that came from these meetings was clear - "we must progress these products because delivery on time is important to this firm". However for the fourth meeting of every month the production manager would draw up an agenda which only featured the most valuable jobs. Once again the message was clear - "we must maximise the monthly sales figures". When asked why he did this the production manager explained that he knew that at the end of the month he would have to tell the managing director how much the production function had shipped in terms of sales during the month. The production manager believed that his performance was measured against the value of sales shipped, but knew that if the company delivered late then they were less likely to get repeat orders. Hence he was being influenced by the performance measures he was subject to, but was setting explicit goals to influence the actions of his subordinates.

In Japan sectional performance was often evaluated using check sheets on which the head of the section would record his subjective opinion of how well his subordinates had performed. Usually these check sheets consisted of specific categories which reflected the current strategic thrusts of the business. The data generated were fed back to employees at regular monthly meetings and areas of poor performance were discussed. In fact feedback on performance was common in Japan and widely used at some of the companies visited in the U.K. In most of the Japanese plants brief meetings were held in each section on a daily basis. These were used to notify everyone of any problems that were likely to need special attention during that day. Monthly meetings involving everyone were also common. Typically these would be chaired by a plant director and consist of a presentation which emphasised the importance of both the manufacturing task and continual improvement. Other forms of feedback observed in both the U.K. and Japan include; posters, wall charts, digital displays, and benchmarking. At company 1, the output of the plant's presses was compared with that of its sister plants and plotted on a graph which was displayed on the shop floor. At companies 9 and 10 the key performance measures for manufacturing had been derived from the business strategy and the section heads held monthly feedback meetings with their subordinates at which performance versus the key measures was discussed.

Figure 5.6 summarises the data generated during the follow-up study and shows that manufacturing managers do indeed try to influence behaviour of their subordinates through the goal setting, performance measurement, feedback and reward systems. Hence it seems reasonable to conclude that the model shown in figure 5.1 is applicable to the manufacturing function. Two additional

Figure 5.6: Summary of the data collected during the follow-up study

Company	Location	Manufacturing task	Does this firm use its systems to induce appropriate behaviour?			
			Goal Setting	Performance Meas.	Feedback	Reward
1	U.K., but Japanese transplant	Conformance, product reliability and low cost	Yes	To an extent	Yes	Not explicitly, but some link provided by appraisal system.
2	U.K.	Costs, conformance, lead time and delivery reliability	Yes, but with a strong financial focus	Yes, but with a strong financial focus	Yes, but with a strong financial focus	Yes, but with a strong financial focus
3	U.K.	Product perf, delivery reliability and cost	Yes, for delivery reliability	Yes, for delivery reliability and cost	Yes, for delivery reliability and cost	Yes, but with a strong financial focus
4	U.K.	Delivery lead time, delivery reliability and cost	Yes	Yes, for delivery reliability and cost	To an extent	Yes, primarily cost, but some emphasis on quality.
5	Japan	Delight the customer through creativity, profit/cost internally	Yes, hoshin kanri	To an extent	To an extent	Not explicitly
6	Japan	Product perf, cost/price and delivery	Yes, hoshin kanri	Yes	Yes	To an extent
7	Japan	Quality and cost	Yes	Yes	To an extent	To an extent

Figure 5.6 (Continued): Summary of the data collected during the follow-up study

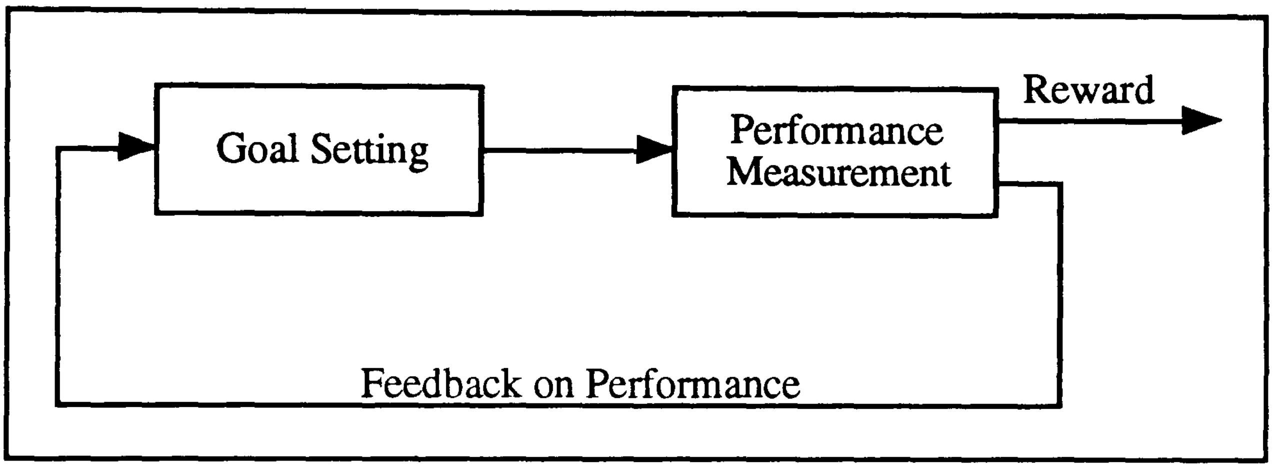
Company	Location	Manufacturing task	Does this firm use its systems to induce appropriate behaviour?			
			Goal Setting	Performance Meas.	Feedback	Reward
8	Japan	Product perf, reliability, cost and efficiency	Yes, hoshin kanri	Yes	Yes	Not explicitly
9	Japan	Reliability and efficiency	Yes, hoshin kanri	Yes	Yes	Not explicitly
10	Japan	Cost	Yes, hoshin kanri	Yes	Yes	Not explicitly
11	Japan	Cost, delivery lead time and flexibility	Yes, hoshin kanri	Not discussed	Not discussed	Not discussed
12	Japan	High quality, high performance	Yes	Yes	Yes	To an extent
13	Japan	Product perf, delivery reliability, profit & selling price	Yes, hoshin kanri	To an extent	Yes	Not explicitly
14	Japan	Not discussed	Yes, hoshin kanri	Not discussed	Not discussed	Not discussed

points should be noted. The first is that despite careful design some systems actually encourage the firm's employees to take actions which conflict with the manufacturing task. Hence the system congruence audit needs to include a mechanism which can highlight this. Second, it is questionable whether reward should be directly linked to the manufacturing task.

5.3: **Operationalising the model**[21]

The pilot version of the system congruence audit was based on a modified version of the model shown in figure 5.1 and took account of the question of whether a firm's reward systems should be used explicitly to reinforce the importance of the manufacturing task (see figure 5.7).

Figure 5.7: Modified stimulus-response model



As mentioned in the introduction, auditing the level of system congruence involves examining the extent to which the firm's systems stimulate decision making and action consistent with the manufacturing task. To do this the manufacturing task must be defined, the firm's systems identified, and the extent to which they induce appropriate behaviour determined. The first step in this process - the definition of the manufacturing task - forms part of the full congruence audit described in chapter 6. Hence there are two stages to the system congruence audit; (a) identifying what the firm's systems are and (b) determining whether they lead to appropriate behaviour. As with the goal congruence audit a structured interview was used to collect the relevant data. The format of this interview and the associated data collection techniques are

21 This section is based on Neely and Wilson (1992c).

described in this section.

5.3.1: Identifying the systems

Following the standard first phase of the interview, described in the previous chapter, the stimulus-response model shown in figure 5.7 was explained to the interviewee. Experience gained during the shadowing exercise and follow up study showed that the terms goal setting, performance measurement, feedback on performance and reward are often confused. Hence as the stimulus-response model was being explained it was emphasised that; (a) goal setting referred to planned attainment targets; that is targets, or goals, that are set and pursued, (b) performance measurement referred to past action and is the mechanism used to monitor how successfully the planned actions were executed, (c) feedback on performance referred to information fed back to the individual either about their, the department's or the firm's performance and (d) reward referred to all forms of reward, some of which may be non-financial.

Once the model had been explained, the interviewee was asked to identify which systems they were subject to. A hierarchy of probing questions was used. The first level of probe was an open question of the form; "what goal setting (performance measurement, information feedback, reward) systems are you subject to". As soon as the interviewee appeared to feel that they had identified all of the relevant systems they were prompted with a question of the form; "any others". The third level of probe involved asking the interviewee direct questions which sought to identify if there were subject to any other systems which related directly to the various elements of the manufacturing task (the manufacturing missions). Hence, at the third level of probe, questions of the following format were asked; "are you subject to any goal setting (performance measurement, information feedback, reward) systems which you have not yet identified and which relate to, for example, delivery of products on time". The output from the first stage of the interview, then, was a list of the systems the interviewee was subject to. A check sheet of the format shown in figure 5.8 was used to collect the data.

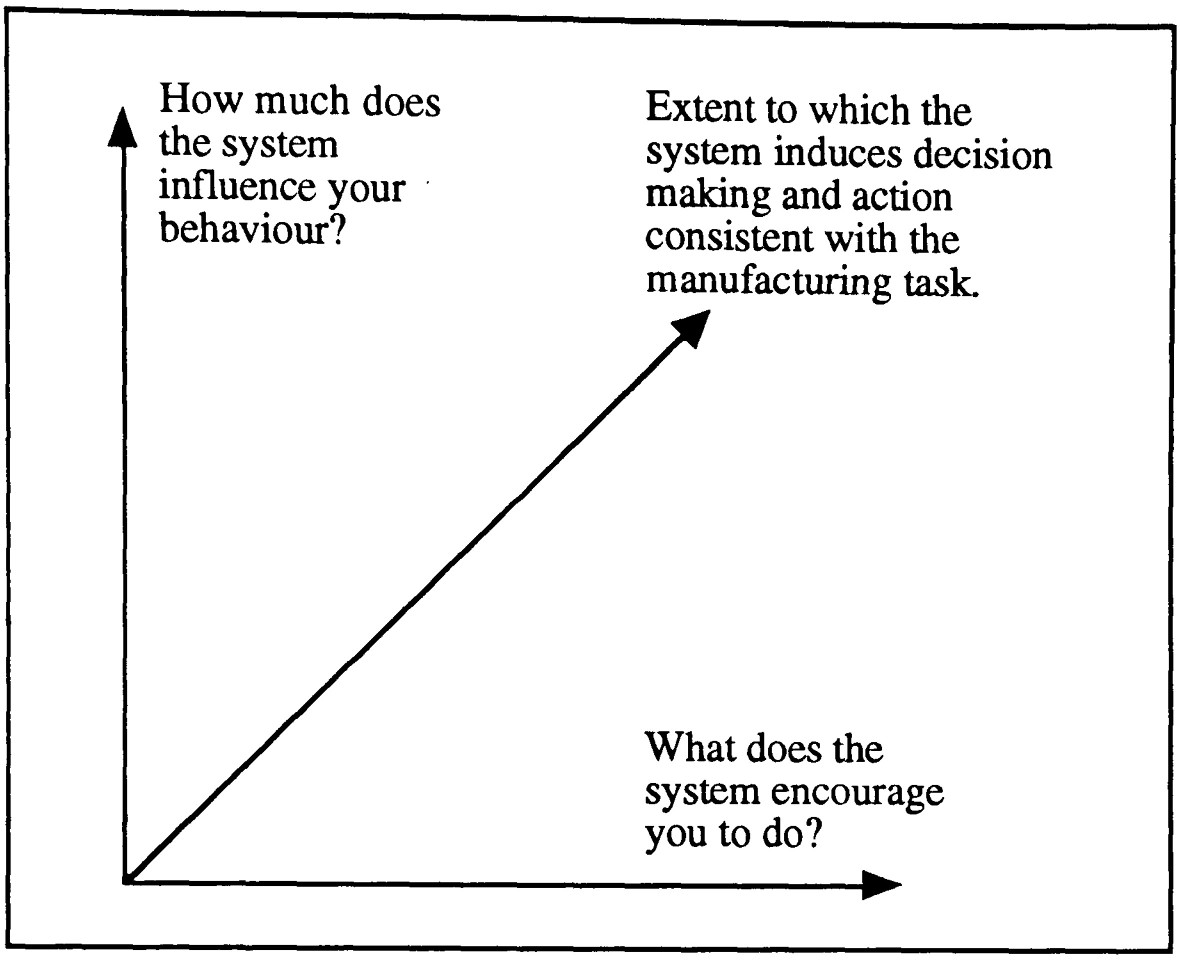
Figure 5.8: Check sheet used to record data on the organisation's systems

Questions	Goal Setting	Performance Measurement	Information Feedback	Reward
Open				
Prompt				
Manufacturing Mission A				
Manufacturing Mission B				
Manufacturing Mission C				
Manufacturing Mission D				
Manufacturing Mission E				

5.3.2: Determining the level of system congruence

The next stage of the interview was designed to establish the extent to which the systems that had already been identified induced decision making and action consistent with the various elements of the manufacturing task (the manufacturing missions). There appear to be two dimensions to this problem. The first involves identifying what signals a particular system sends to the interviewee. The second relates to determining how much the system influences the interviewee. Take, for example, company A's goal setting system - the weekly production schedule. While this was explicitly related to the manufacturing mission "we must ensure that we deliver on time" the head of one department claimed that he ignored the schedule - hence the system appears to have had little influence over his actions. This is an important point as it emphasises that simply designing strategic control systems so that they send the right signals is insufficient. One also has to ensure that the appropriate level of importance is attributed to the system. Figure 5.9 shows this diagrammatically.

Figure 5.9: The Two Dimensions of Influence



In the second stage of the interview, then, two sets of questions had to be asked. First the interviewee had to be asked what each of the previously identified systems encouraged them to do. Next the interviewee had to be asked how strongly each system influenced them. The check sheet shown in figure 5.10 was used to collect the data that were generated.

In the first column the names of the systems identified in the first part of the interview were entered. To complete the second column the interviewee was asked how much each system influenced their actions. These data were generated using Saaty's pairwise comparison process (see chapter 4). Hence the interviewee was first asked which of two systems influenced their actions most and then to identify the number from Saaty's scale which most accurately reflected the strength of their feeling. The remaining columns were filled by asking the interviewee whether the system under examination encouraged them to take actions consistent with the various manufacturing missions. A scale of +2 to -2 was used for this. If the system strongly encouraged the interviewee to take actions consistent with the mission a value of +2 was entered in the appropriate cell. If, however, the system had no relationship with the mission a value of zero was entered into the cell. And if the system strongly encouraged the interviewee to pursue a course of action which was inconsistent with the mission a value of -2 was entered into the cell. The values +1 and -1 were used to signify intermediate levels of encouragement.

Figure 5.10: Data collection check sheet for the second stage of the interview

Systems	How strongly does this system influence you?	Does the system encourage you to take actions congruent with manufacturing mission A?	Does the system encourage you to take actions congruent with manufacturing mission B?
	Σ=100		

Multiplying the second column by the entry in each of the remaining cells gave an indication of the extent to which the system under examination encouraged the interviewee to pursue a course of action congruent with a specific manufacturing mission. Summing the rows gave a measure of the total emphasis that the firm's systems placed on each mission. These calculations will be explored more fully in the next chapter, when the integrated audit is presented. The remainder of this section focuses on the data collection process as the pilot interviews showed that this needed to be enhanced.

5.3.3: **Pilot study**

Once the pilot version of the system congruence audit had been developed it was briefly piloted in company C. As the concept of system congruence had already been explored during the testing of the stimulus-response model shown in figure 5.1 and the data collection techniques used in the pilot version of the audit were similar to those used in the goal congruence audit, it was decided that the methodology would only be piloted on a small scale. Hence two people, one foreman and one operative, were interviewed. During the interviews it quickly became apparent that asking the interviewees to identify the systems was a mistake because they were unable to remember all of them. Figures 5.11 and 5.12 show the systems that the two interviewees were able to identify. Table 5.3 lists the systems that were identified by all the managers of manufacturing at their next monthly production meeting (see chapter 6).

Figure 5.11: Systems identified by a foreman during an interview

Questions	Goal Setting	Performance Measurement	Information Feedback	Reward
Open	Target times & due dates	Informal	Not relevant	Spot bonus, flat rate, plus rate
Prompt				
Manufacturing Mission A				
Manufacturing Mission B				
Manufacturing Mission C				
Manufacturing Mission D				
Manufacturing Mission E				

Figure 5.12: Systems identified by an operative during an interview[22]

Questions	Goal Setting	Performance Measurement	Information Feedback	Reward
Open		Informal	Informal	Spot bonus, flat rate
Prompt				Xmas turkey
Manufacturing Mission A				
Manufacturing Mission B				
Manufacturing Mission C				
Manufacturing Mission D				
Manufacturing Mission E				

Because of the problems each interviewee experienced with defining the systems the remainder of the pilot interview had to be aborted. This, however, did not cause a problem because Saaty's pairwise comparison process had already been used in the goal congruence audit and discussion with the interviewees showed that they would be quite happy to use a +2 to -2 scale to say whether they thought the system under examination encouraged them to make decisions and take actions which were consistent or inconsistent with the manufacturing task, especially if the questions were incorporated into a questionnaire. As will be seen from the integrated congruence audit described in chapter six, then, the brief piloting of the system congruence audit enabled the author to identify two ways of enhancing it. The first was to ask the

22 The manufacturing missions referred to in figures 5.11 and 5.12 had already been defined by company C's management group and reviewed by the managing director as part of the integrated congruence audit. See chapter 6 for more detail.

management group to identify the relevant systems in advance. The second was to design a questionnaire to collect some of the necessary data. It should be noted that an additional benefit of the questionnaire was that it created more time for the author to analyse the data during the course of the interview.

Table 5.3: Systems identified during the monthly production meeting

	Systems applying to the foreman	Systems applying to the operatives
Goal Setting	Routing card Mthly prod meeting Wkly prod meeting Factory call off requirements sheet	Routing card
Performance Measurement	Cost report	
Feedback	Informal feedback on performance	Informal feedback on performance
Reward	Basic salary Xmas bonus (turkey) Annual cash bonus	Basic weekly salary Guaranteed bonus Plus rate Spot bonus Xmas bonus (turkey)

5.4: **Summary**

In this chapter the testing and development of the system congruence audit has been described. The audit was designed to identify areas of system incongruence in firms. The preliminary investigations, involving a week long shadowing exercise and follow-up discussions with managers of fourteen companies, showed that when auditing system congruence one has to consider all the elements of a traditional strategic control system, namely; goal setting, performance measurement, information feedback and reward. A pilot data collection methodology was presented and tested. Following this minor modifications to the methodology were proposed. The focus of the last two chapters has been on the development and testing of the isolated audits. In the next one an integrated version of these audits will be documented and it will be shown how this congruence audit can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy.

CHAPTER 6: CONGRUENCE AUDIT

CHAPTER 6: CONGRUENCE AUDIT

6.0: Introduction

Chapters four and five discussed phases one and two of this research - the development and testing of the pilot versions of the goal and system congruence audits. The main themes raised in those chapters can be summarised as follows:

(a) The manufacturing task consists of a number of factors (manufacturing missions) which are themselves a function of both the company's objectives and the customer's requirements.

(b) The lack of goal congruence is often due to the prioritisation of the manufacturing missions rather than their definition.

(c) Manufacturing managers use the goal setting, performance measurement, feedback and reward systems to encourage decision making and action consistent with the manufacturing missions.

(d) Two things influence whether a given system induces appropriate behaviour; what the system encourages employees to do and how much the system influences their behaviour.

A number of process points also emerged during the piloting of the goal and system congruence audits. These can be summarised as follows:

(a) To minimise the length of the individual interviews the manufacturing missions should be defined in advance.

(b) To minimise the length of the individual interviews the systems used to induce decision making and action consistent with the manufacturing missions should be identified in advance.

(c) The reliability of the individual interviews can be enhanced by structuring them formally.

(d) The validity of the individual interviews can be enhanced by using a computer to analyse the data gathered during them and then asking the interviewee to comment on the results.

Together these themes and process points provide the guidelines which shaped the design of the congruence audit. Following its development this audit was applied to two firms to establish whether it could be used to identify some of the reasons why they might have been unable to realise their manufacturing strategies. The data gathered during these case studies and the structure of the congruence audit are documented in this chapter.

The remainder of the chapter has been split into four sections. In section 6.1 the congruence audit is described. In sections 6.2 and 6.3 the case studies are presented. In section 6.4 the chapter is summarised.

6.1: **The congruence audit**

The congruence audit consisted of two phases. The first involved a group discussion with a senior management team. The second comprised a series of structured interviews. During the group discussion the manufacturing missions were defined and prioritised, and the firm's systems were identified. In the structured interviews each interviewee was asked to prioritise the pre-defined manufacturing missions, to quantify the extent to which the firm's systems encouraged them to act in a manner consistent with the manufacturing missions, and to explain any discrepancies that emerged. The actual format of the management group discussion and individual interviews is detailed in sections 6.1.1 and 6.1.2 respectively.

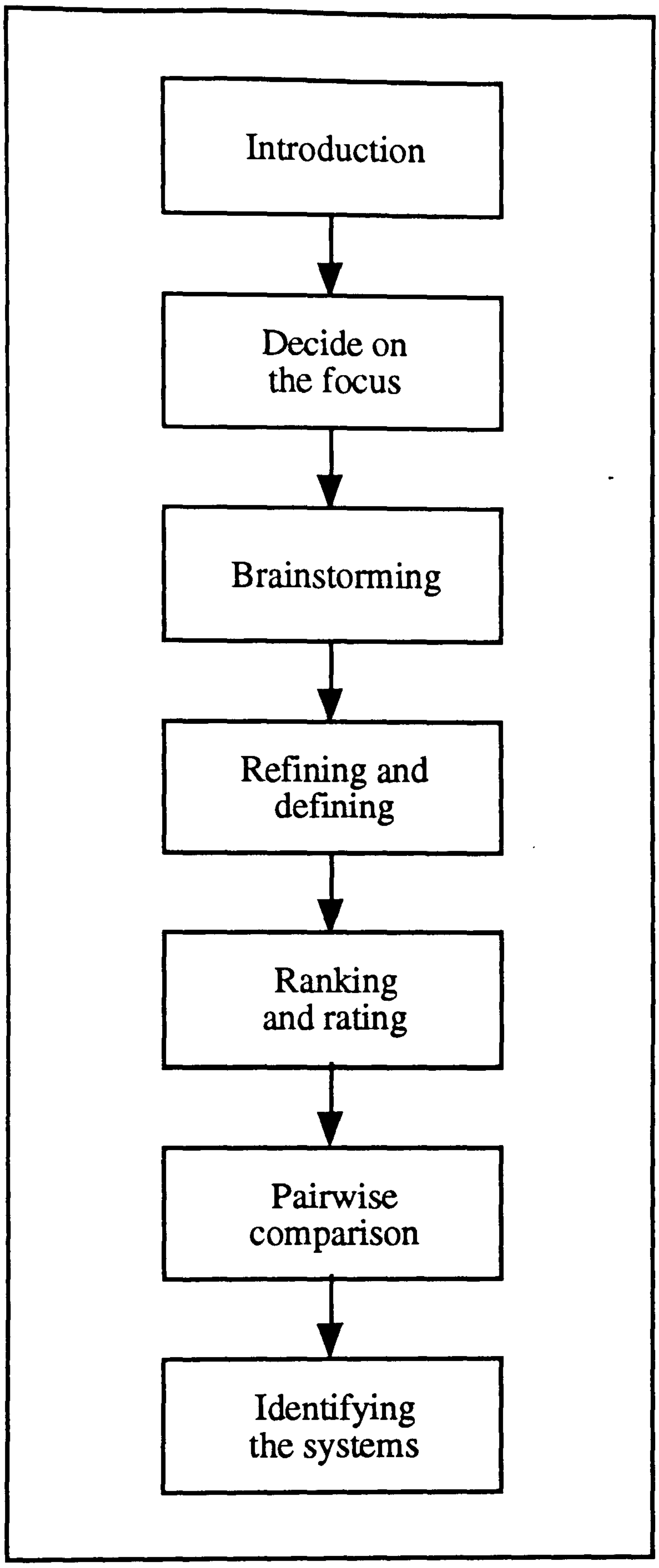
6.1.1: Management group discussion

Figure 6.1 shows a flowchart which summarises the structure of the management group discussion. As can be seen the discussion consisted of seven stages. During the introduction the purpose of the discussion and its structure was explained. Following this the management group was asked to identify which product or customer they wished to focus on (Hill, 1985; Skinner, 1974a; Wheelwright, 1978). This was done to ensure that everyone adopted a common perspective. The product or customer chosen was formally recorded and the management group was reminded that they were focussing on product "XYZ" or customer "ABC" at regular intervals during the remainder of the discussion.

As mentioned earlier a manufacturing task consists of a number of manufacturing missions which are themselves a function of a variety of internal and external factors. The purpose of the third stage of the management group discussion - brainstorming - was to identify these factors. The facilitator began the brainstorming session by presenting the framework shown in figure 6.2. The inclusion of the catch-all category "other" should be noted. While it might be possible to define the manufacturing missions in terms of quality, time, price (cost) and flexibility, there are "other" factors which can be important to either a company or its customers. Take, for example, Western society's current concern for the environment. It is likely that manufacturing industry will come under increasing pressure from environmentalists during the next few years. The inclusion of the category "other" ensures that there is scope within the framework for the importance of such issues to be acknowledged.

Once figure 6.2 had been explained the management group was asked what they thought would make people buy their firm's products rather than those of their competitors. The use of the conditional tense in this question should be noted. This encouraged the management team to identify both those factors that already offered the firm a competitive advantage, as well as those that might do so in the future.

Figure 6.1: Structure of the management group discussion



A series of probing questions were used to enhance the validity of the data collected during this stage. The first level of probe was an open question of the form; “what would make people buy your products rather than those of your competitors”. The second was a prompt such as; “are there any other things that you can think of which might make people buy your products rather than those of your competitors”. The third level of probe was a direct question of the form; "do you think that people would buy your products rather than those of your competitors if they were more aesthetically pleasing". This third question was repeated for all the relevant dimensions of quality, time, cost, and flexibility (see figure 4.23). Once the management team had identified those factors that were externally important they were asked to identify those that were internally important. A similar hierarchy of probing questions was used.

Figure 6.2: Framework used to define the manufacturing missions

	External Market Requirements	Manufacturing Missions	Internal Corporate Objectives
Quality			
Time			
Price (Cost)			
Flexibility			
Other			

In the fourth stage of the management group discussion the manufacturing missions were defined. This was an iterative process during which the management group was asked to answer the following question; "what are the implications for the manufacturing function of those factors that have been identified as internally and externally important". Figure 6.3 shows a completed version of the framework shown in figure 6.2. It summarises the manufacturing missions defined by directors of company B[23] and shows how these relate to the factors that were previously identified as internally and externally important. Take, for example, the factors; value for money, profitable machine, profit, market share, improved liquidity, and project funding. Following much debate the directors of company B decided that the implication of these factors could best be summed up by two manufacturing missions; (a) project costs must be minimised and (b) idle work in progress must be minimised.

During the next two stages of the group discussion the manufacturing missions were prioritised. This was done first by the individual members of the management group and then by the group as a whole. The reason that the managers were asked to prioritise the manufacturing missions individually was that this maximised the probability that any differences of opinion that existed within the group would emerge. To save time the managers were simply asked to individually rank and rate the manufacturing missions. The data generated were recorded on a check sheet of the format shown in figure 6.4 and any apparent differences of opinion explored.

Next the group as a whole was asked to prioritise the missions. The pairwise comparison process described in section 4.3.3 was used to do this. The managers were first asked to say which of two missions was of greatest importance to the long run success of the firm and then to identify the number on Saaty's scale that most accurately quantified the strength of their feeling.

[23] Following the piloting of the goal congruence audit the directors of company B decided that they wanted to develop a manufacturing strategy for the firm. The author facilitated the first stage of this process - the definition of the manufacturing missions - using the previously described methodology. Figure 6.3 shows the result of this.

This process ensured that any remaining differences of opinion were resolved as the management group had to reach a consensus before any data were entered into the pairwise comparison matrix. As usual the data were analysed immediately and fed back in the form of a pie-chart. The consistency ratio (see Appendix II) provided an indication of the validity of the data that had been collected.

Figure 6.3: Company B's manufacturing missions

	Market Requirements →	Manufacturing Missions	← Corporate Objectives
Quality	Quality, reliability, service, durability, aesthetics.	All products must be manufactured so that they conform to the customer's specification.	Company image, technological development.
Time	Time to customer, delivery on time.	All products must be delivered to the agreed schedule.	
Cost (Price)	Value for money, Profitable machine.	Project costs must be minimised. Idle work in progress must be minimised.	Profit, market share, improve liquidity, project funding.
Flexibility			
Other	Innovation, customer relations, safety.	Co-operative involvement to improve efficiency should be encouraged.	Support work force, improve cohesion.

In the final stage of the discussion - identification of the firm's systems - the check sheet shown in figure 5.8 was used. First the stimulus-response model shown in figure 5.7 was explained. Then the managers were asked to identify which systems were used to reinforce the importance of the manufacturing missions. The hierarchy of probing questions described in section 5.3.1 was employed to ensure that all the appropriate systems were identified.

Figure 6.4: Check sheet used to record management rankings and ratings

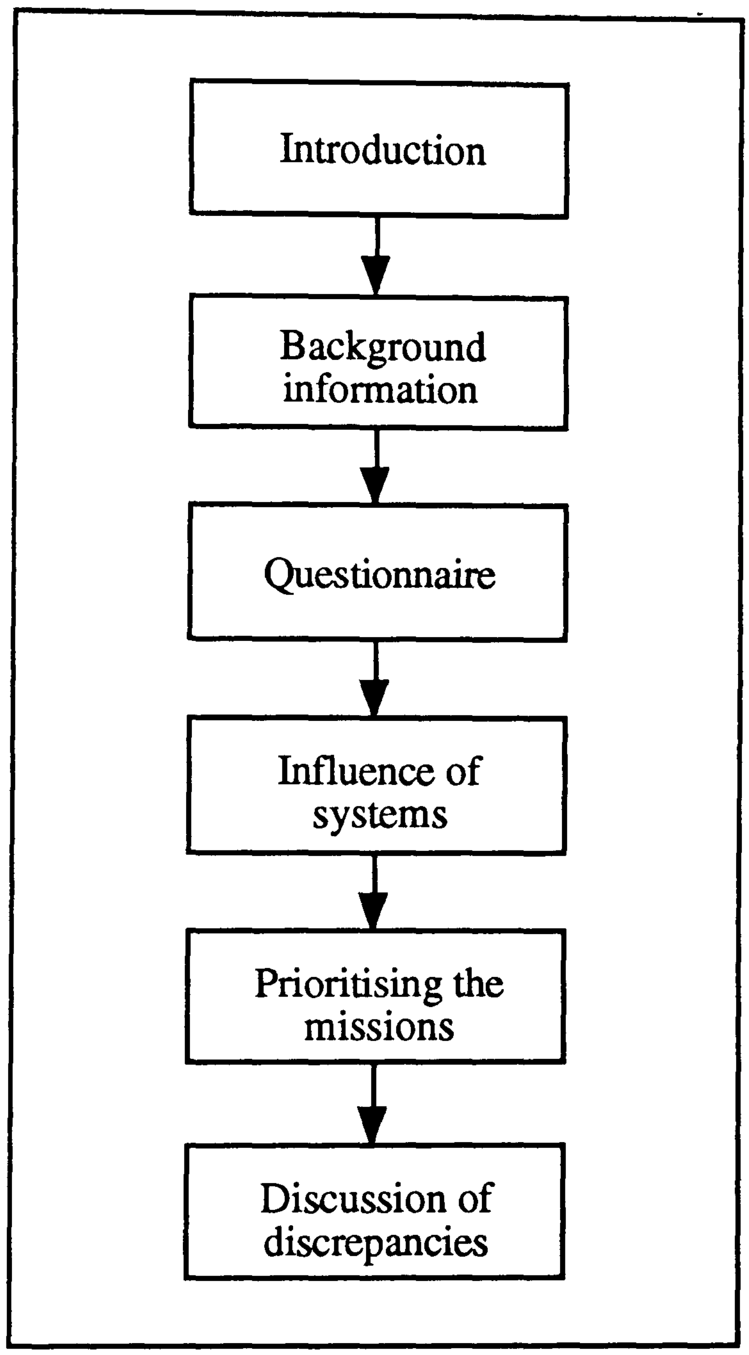
		Name of Manager						Group
Mission	Ratings							
	Rankings							
Mission	Ratings							
	Rankings							
Mission	Ratings							
	Rankings							
Mission	Ratings							
	Rankings							
Mission	Ratings							
	Rankings							

At the end of the management group discussion, then, the firm's manufacturing missions had been defined and prioritised, and the systems used to induce decision making and action consistent with them had been identified. Together these two sets of data formed the basis for the next stage of the congruence audit, the individual interviews.

6.1.2: **Individual interviews**

Figure 6.5 shows a flow chart which summarises the structure of the individual interviews. As can be seen these interviews consisted of six stages. Initially the purpose of the study was explained and the interviewee was assured that any data gathered during the interview would remain confidential. Next the interviewer asked background questions of the format suggested in section 4.3.1. The data generated were recorded on the check sheet similar to the one shown in figure 4.6. As previously discussed, the purpose of this phase of the interview was to; help the interviewee relax and furnish the interviewer with information that may have proved relevant in the subsequent discussions.

Figure 6.5: Structure of the individual interviews



In the third stage of the interview data were collected which showed whether the previously identified goal setting, performance measurement, feedback and reward systems encouraged the interviewee to take actions congruent with the pre-defined manufacturing missions. These data were generated as the interviewee completed a company specific questionnaire. Each page of the questionnaire dealt with a different system. Each question focussed on a different mission. Figure 6.6 shows the generic structure of each question.

Figure 6.6: The generic structure of each question

Q. The **"xyz system"** encourages me to **"abc manufacturing mission"**.

- ☐ Strongly agree
- ☐ Agree
- ☐ No relationship
- ☐ Disagree
- ☐ Strongly disagree

If the interviewee were to indicate that they strongly agreed with the statement in figure 6.6 then it would be assumed that the system under examination strongly encouraged them to take actions congruent with the manufacturing mission. If, on the other hand, they disagreed with the statement it would be assumed that the system actually encouraged them to pursue courses of action which conflicted with the manufacturing mission. It should be noted, however, that there are actually two reasons why an interviewee may disagree with the statement. The first is as described above, but the second is if the system does not relate to the manufacturing mission under examination. Take, for example, the statement "the management by results system encourages me to provide products that work the first time and thereafter for as long as required". An interviewee might disagree with this statement because the management by results system **actively encourages him not** to provide that work the first time and thereafter for as long as required. Alternatively he might disagree with the statement, quite simply, because the management by results system **does not encourage him** to provide that work the first time and thereafter for as long as required. For the purpose of this questionnaire, however, the appropriate response in the latter case is no relationship and not disagree. Hence whenever an interviewee disagreed with one of the statements he would be asked to confirm that the system actually encouraged him to pursue a course of action which conflicted with the manufacturing mission under examination, rather than simply bearing no relationship to it.

The data collected in the third stage of the interview were entered directly onto a spreadsheet of the format shown in figure 6.7. To do this the responses were converted into a numerical scale. A value of +2 corresponded to a response of strongly agree, a value of 0 corresponded to a response of no relationship, and a value of -2 corresponded to the response strongly disagree.

Figure 6.7: Check sheet for recording data generated during the interviews

		Manufacturing Missions						
System	Influence	A	B	C	D	E	F	G
1		+1	+1	+1	0	+2	-1	+2
2		-2	+2	0	+1	+1	+1	+2
3		-1	+2	+2	0	+1	0	+2
4		0	+1	+2	-1	+2	0	+2
5		+1	+2	+2	+1	-1	+2	0
Emphasis from systems								
Actual prioritisations								
Management Group								

The data shown in the first row of figure 6.7, then, suggest that system 1:

-Encouraged the interviewee concerned to pursue courses of action which were congruent with manufacturing missions A, B, and C.

-Bore no relationship to manufacturing mission D.

-Strongly encouraged the interviewee concerned to pursue courses of action which were congruent with manufacturing missions E and G.

-Encouraged the interviewee concerned to pursue courses of action which conflicted with manufacturing mission F.

This stage of the interview, then, generated data which showed what the firm's systems encouraged an interviewee to do. As mentioned earlier, however, the extent to which a specific system induces behaviour consistent with a given manufacturing mission is a function of what the system encourages someone to do and how strongly it encourages them to do it. Hence the fourth stage of the interview sought to collect data which quantified how much each system influenced the interviewee. These data were generated using the pairwise comparison process described in section 4.3.3. First the interviewee was asked which of two systems influenced their behaviour most. Second they were asked to identify the number from Saaty's scale which most accurately reflected the strength of their feeling. The resultant data were analysed immediately, presented to the interviewee on a pie-chart, and then entered onto the spreadsheet shown in figure 6.8 under the column headed influence.

Once the third and fourth stages of the interview had been completed the extent to which the firm's systems induced behaviour consistent with each of the manufacturing missions could be calculated. Multiplying the influence the system had on the interviewee by what it encouraged them to do (the data gathered from the questionnaire) gave a measure of how much a given system reinforced the importance of a specific manufacturing mission. To calculate the total emphasis the systems placed on a given manufacturing mission, then, it was necessary to calculate the emphasis that the individual systems placed on each manufacturing mission and sum the results. Take, for example, manufacturing mission A. The data in figure 6.8 show that:

(a) System 1 had a 25% influence over the interviewee's decisions and actions, and encouraged (+1) him to behaviour in a manner congruent with manufacturing mission A. Therefore system 1 induced behaviour consistent with manufacturing mission A to the tune of 25 (1x25).

(b) System 2 had a 10% influence over the interviewee's decisions and actions, but strongly encouraged (-2) him to behaviour in a manner incongruent with manufacturing mission A. Therefore system 2 induced behaviour consistent with manufacturing mission A to the tune of -20 (-2x10).

(c) System 3 had a 10% influence over the interviewee's decisions and actions, and encouraged (1) him to behaviour in a manner congruent with manufacturing mission A. Therefore system 3 induced behaviour consistent with mission A to the tune of 10 (1x10).

(d) System 4 had a 15% influence over the interviewee's decisions and actions, but bears no relationship (0) to manufacturing mission A. Therefore system 4 induced behaviour consistent with mission A to the tune of 0 (0x15).

(e) System 5 had a 40% influence over the interviewee's decisions and actions, and encouraged (1) him to behaviour in a manner incongruent with manufacturing mission A. Therefore system 5 induced behaviour consistent with mission A to the tune of 40 (1x40).

(f) Together the systems induced behaviour congruent with manufacturing mission A to the tune of 35 (25-20-10+0+40).

Figure 6.8 shows the completed calculations. Once these data had been generated they were normalised and expressed as percentages (see figure 6.9).

Figure 6.8: Calculating the extent to which the systems reinforce the missions

		Manufacturing Missions						
System	Influence	A	B	C	D	E	F	G
1	25%	+1	+1	+1	0	+2	-1	+2
2	10%	-2	+2	0	+1	+1	+1	+2
3	10%	-1	+2	+2	0	+1	0	+2
4	15%	0	+1	+2	-1	+2	0	+2
5	40%	+1	+2	+2	+1	-1	+2	0
Emphasis from systems		35	160	155	35	60	65	120
Actual prioritisations								
Management Group								

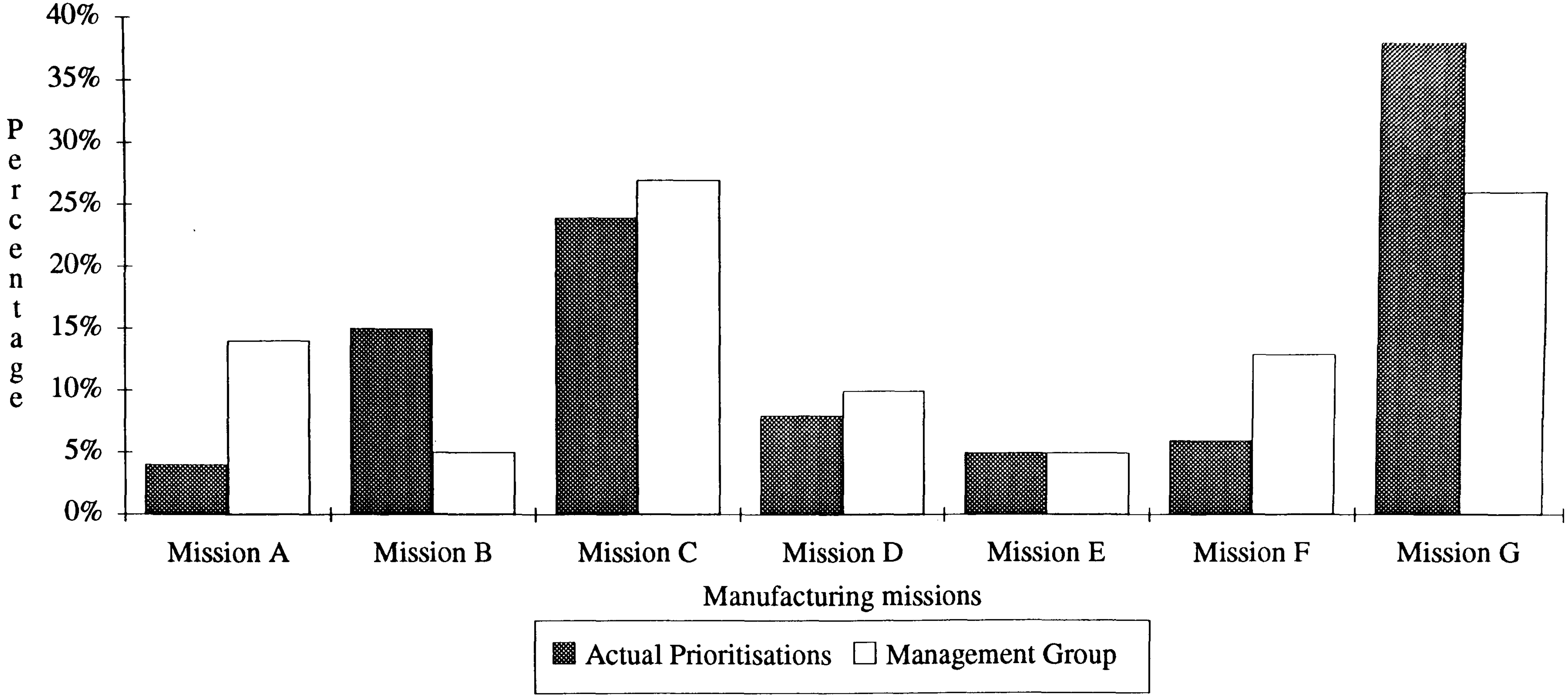
In the next stage of the interview the interviewee was shown the manufacturing missions defined by the management group and asked to prioritise them. Saaty's pairwise comparison process was used and each interviewee was asked questions of the form; "which do you think is more important to the long run success of the firm - manufacturing mission A or manufacturing mission B". The data were analysed immediately and added to the spreadsheet to complete the row labelled "actual prioritisations". The last row, labelled "management group", contained a summary of the way in which the manufacturing missions had been previously prioritised by the management group. Figure 6.9 shows a completed version of the spreadsheet.

Figure 6.9: Completed check sheet for the individual interviews

		Manufacturing Missions						
System	Influence	A	B	C	D	E	F	G
1	25%	+1	+1	+1	0	+2	-1	+2
2	10%	-2	+2	0	+1	+1	+1	+2
3	10%	-1	+2	+2	0	+1	0	+2
4	15%	0	+1	+2	-1	+2	0	+2
5	40%	+1	+2	+2	+1	-1	+2	0
Emphasis from systems		6%	25%	25%	6%	10%	10%	19%
Actual prioritisations		4%	15%	24%	8%	5%	6%	38%
Management Group		14%	5%	27%	10%	5%	13%	26%

The final stage of the interview was the discussion. This involved examining two issues; (a) were there any discrepancies between the way in which the interviewee and the management group had prioritised the manufacturing missions and (b) were there any discrepancies between the way in which the interviewee had prioritised the manufacturing missions and the extent to which the systems induced decision making and action consistent with them. In both cases bar charts showing the relevant data were used to stimulate the discussion. Initially the interviewee was shown how their prioritisations related to those of the management group. Such a bar chart, based on the data in figure 6.9, is shown in figure 6.10.

Figure 6.10: Comparing the interviewee's and management group's priorities



As figure 6.10 highlights the major areas of discrepancy in this instance were with regard to the prioritisation of mission's A, B and G. Hence the interviewee would be asked asked if they could think of any reasons that might explain why; (a) the management group felt that mission A was more important than them and (b) the management group felt that missions B and G were less important than them. Next the interviewee was shown a chart of the same format as the one in figure 6.11. This identifies that the systems place considerably more emphasis on mission B and considerable less on mission G than acknowledged in the interviewee's prioritisations. Once again the reasons for the discrepancies would be explored. As the data presented in the next two sections will show it is principally through these discussions that some of the reasons why a firm may be unable to realise its manufacturing strategy can be identified.

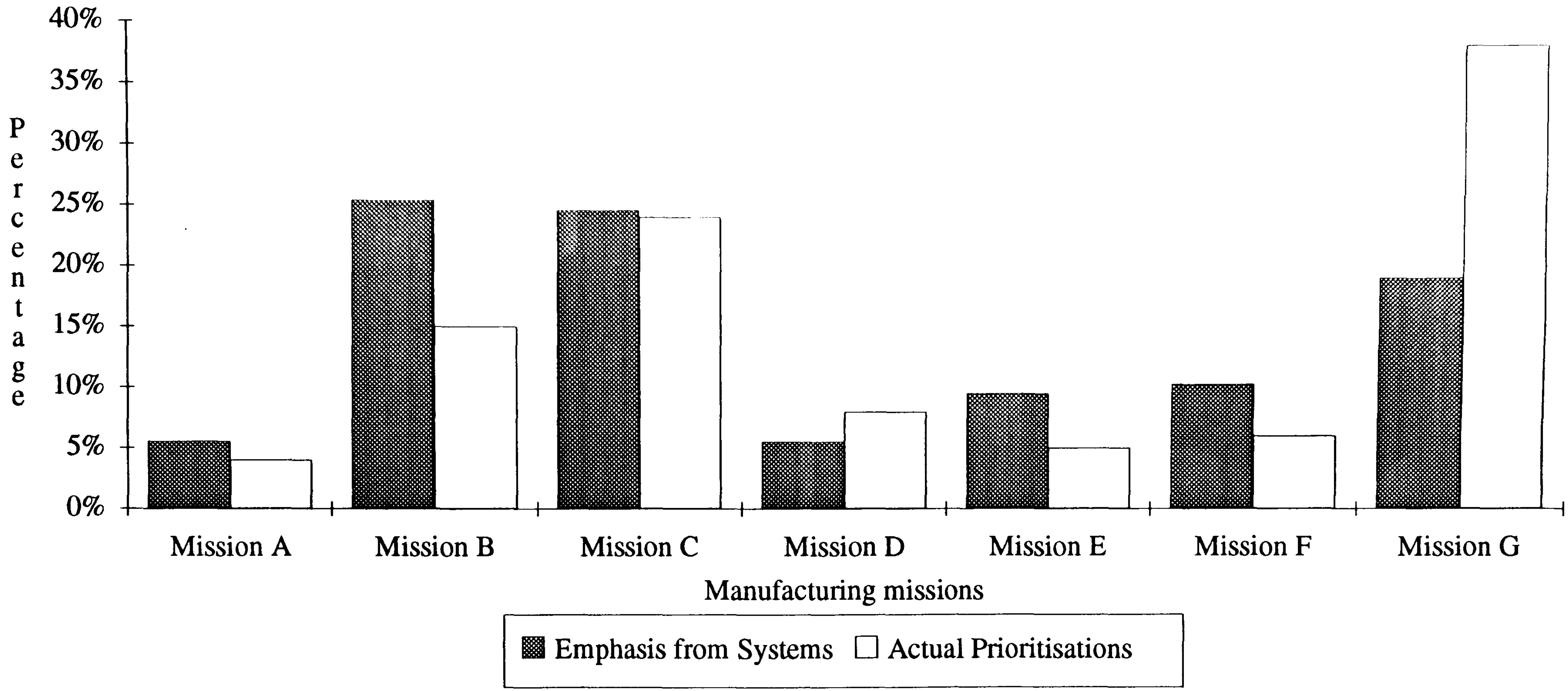
6.2: **Audit in company C**

In the introduction to this chapter it was explained that once the integrated congruence audit had been developed it was applied to two firms. This section presents the data gathered during the first of these cases. The next one documents the data collected during the second[24]. Together the two cases show how the congruence audit can be used.

Company C designs, manufactures and installs a wide range of hardwood, timber, plastic laminate and solid surfacing material products for the construction and shop fitting industries. Following a demerger from its previous owners in 1985 the firm grew rapidly for five years. By 1990 its turnover had increased five fold, to £6 million, and it employed 120 people in the Midlands and a further 80 in London and the South. The data presented in this section were collected when the firm's factory and head office, both of which are situated in the East Midlands, were the subject of a congruence audit.

24 The raw data collected during both of these cases are presented in Appendix V.

Figure 6.11: Comparing the interviewee's priorities and the emphasis from the systems



6.2.1: Management group discussion - company C

The audit began with a management group discussion. Those present included; the contracts manager, the scheduling manager, the production controller, the quality coordinator and the master scheduler. Following the introduction, the group decided to focus on the supply of door sets. Company C offers two types of service - supply, or supply and fit. The supply of door sets was widely acknowledged as company C's core product as it accounted for 40% of turnover. Figure 6.12 shows the market requirements and corporate objectives that were identified as relating to the supply of door sets during the brainstorming stage of the management group discussion.

Once the requirements and objectives had been identified their implications for manufacturing were discussed. This can best be described as an iterative discussion because it involved the gradual refinement of the manufacturing missions. After much debate these were defined as shown in table 6.1.

In the next stage of the group discussion the managers were asked to individually rank and rate the previously defined manufacturing missions. Ranking involved placing the missions in rank order of importance. Hence each manager was asked to assign a value of one to the most important mission and five to the least important mission. The rating was carried out using a numerical scale. Each manager was given a copy of the scale and asked to assign whatever rating they felt was appropriate to each mission. The scale was structured in the same way as Saaty's pairwise comparison scale. Hence:

-1 was said to mean the manufacturing mission was unimportant.

-3 was said to mean the manufacturing mission was of weak importance.

-5 was said to mean the manufacturing mission was of strong importance.

-7 was said to mean the manufacturing mission was of very strong importance.

-9 was said to mean the manufacturing mission was of absolute importance.

Figure 6.12: Market requirements and company objectives for company C

	Market Requirements →	Manufacturing Missions	← Corporate Objectives
Quality	Fit for purpose, ease of assembly, aesthetics, specifications		Right first time.
Time	Delivery on time.		Schedule adherence, minimise lead times.
Cost (Price)	Price, terms of payment.		Minimise costs, especially overtime, efficiency.
Flexibility	Changing delivery schedules.		Meet any customer demands, wide product range.
Other	Protection of product, environmental concerns.		Support work force, improve cohesion.

Figures 6.13 and 6.14, respectively, show how the managers ranked and rated the missions. It should be noted that the quality controller was called away shortly after the manufacturing missions had been defined and hence did not participate in this or the subsequent stages of the discussion.

Due to time constraints the graphs shown in figures 6.13 and 6.14 were not drawn during the discussion. The data they contain, however, were fed back using a matrix of the format shown in figure 6.15. As mentioned earlier the purpose of asking the managers to rank and rate individually the manufacturing missions was to reveal any differences of opinion that existed within the group. The data shown in figure 6.15 highlight two points. First, the production controller, has rated everything as absolutely important (a nine on the scale) and simply ranked the missions in the same order in which they were defined. While these data might accurately reflect his opinion they suggest that it might be necessary to ask him direct questions during the pairwise comparison process if his true opinions are to be drawn out. Second, while there is widespread agreement that manufacturing missions A (delivery on time) and B (producing products which conform to the specifications) are the most important, there is less consistency with regard to the prioritisation of the remaining missions. Hence it is likely that these will need debating more fully.

Table 6.1: The manufacturing missions as defined by the management group - company C

Manufacturing Missions	Definitions
A	Products must be delivered on time.
B	Products must be made so that they conform to the drawing specification the first time.
C	Products must be made with the minimum direct labour cost.
D	The materials which provide the highest added value should be used.
E	Employees should constantly be trained so that they have the ability to do a variety of jobs.

Figure 6.13: Ranking of company C's manufacturing missions

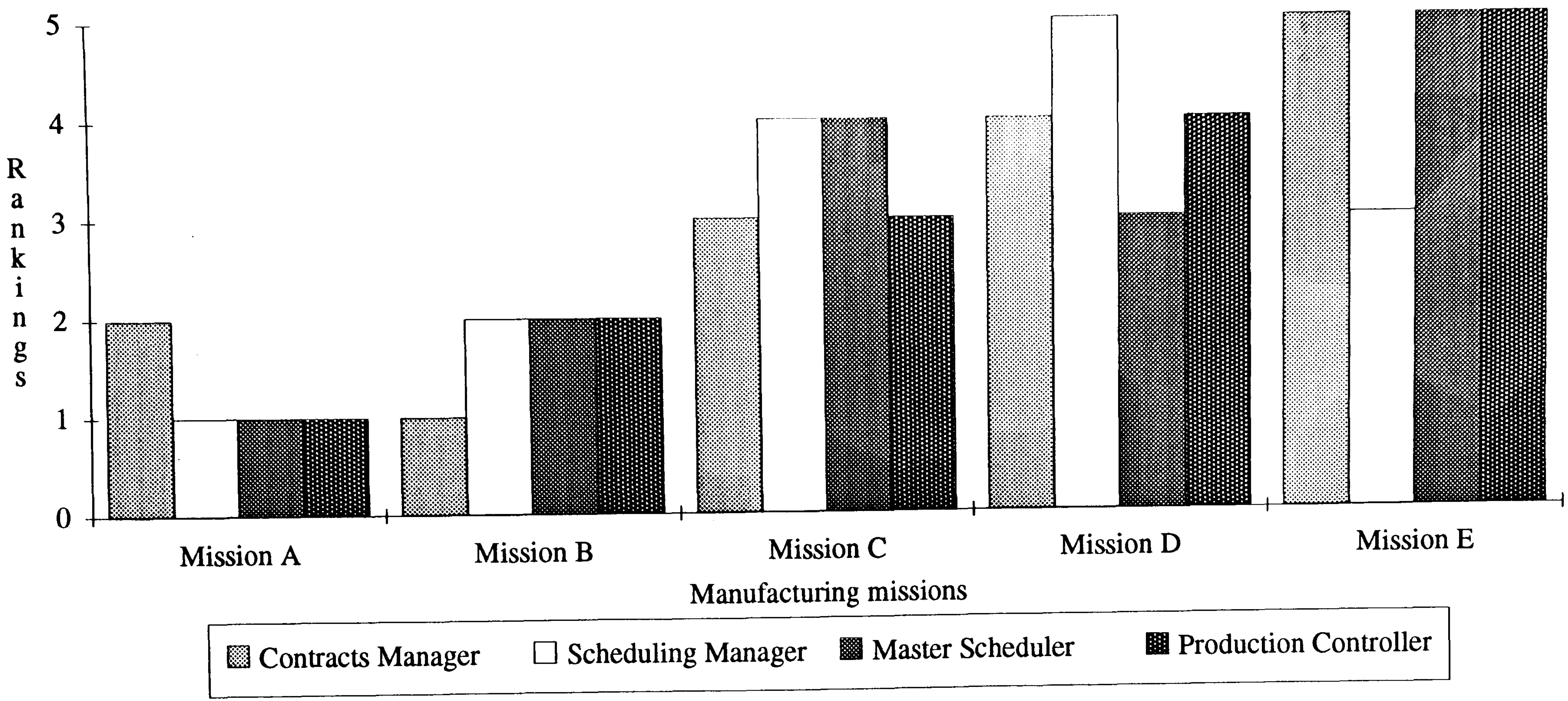
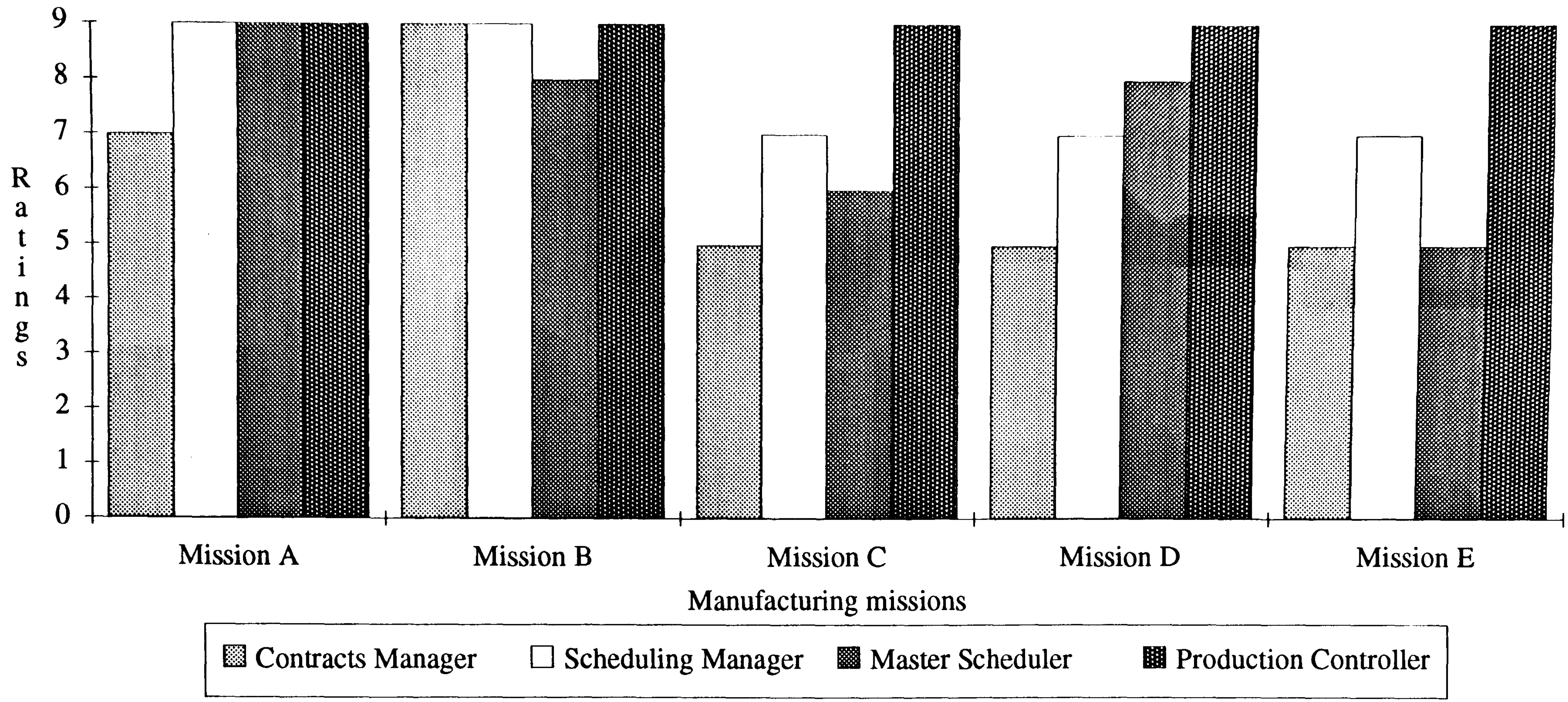


Figure 6.14: Rating of company C's manufacturing missions



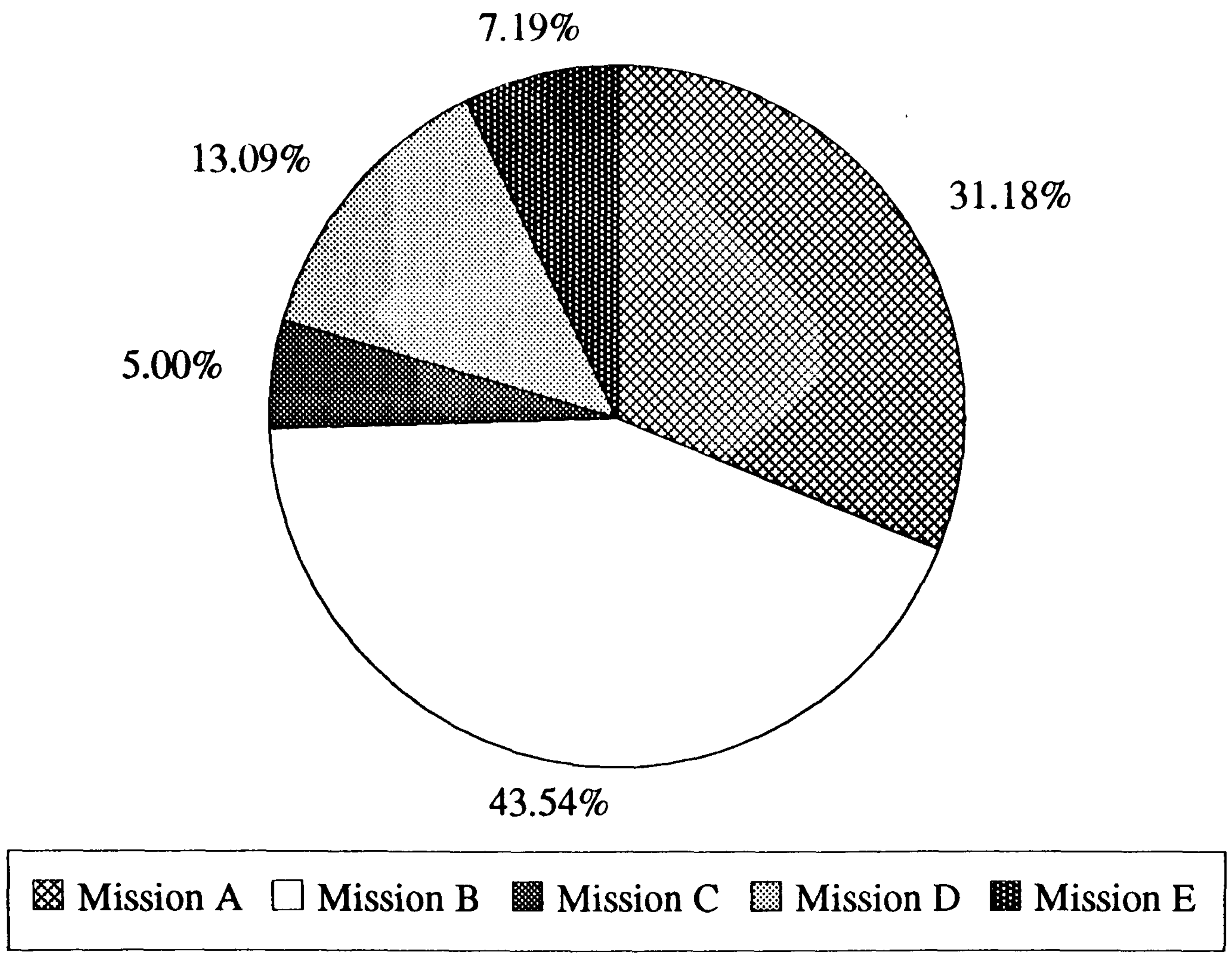
In the next stage of the management group discussion the pairwise comparison process was used to prioritise the manufacturing missions. The process began as the managers were asked to answer the following question; "which do you think is more important to the long run success of this firm - manufacturing mission A or manufacturing mission B". Once the group had decided which of the two missions was the more important they were asked to identify the number on Saaty's scale which most accurately quantified the strength of their feeling. Figure 6.16 shows the way in which the managers of company C prioritised the manufacturing missions. The data generated during the pairwise comparison process were analysed immediately and each member of the management group confirmed that the resultant pie chart summarised the discussion and reflected their opinion.

Figure 6.15: Check sheet used to feedback individual's rankings and ratings

Manufacturing missions		Cont mgr	Sched mgr	Master sched	Prod cont	Group
A	Ratings	7	9	9	9	34
	Rankings	2	1	1	1	1.25
B	Ratings	9	9	8	9	35
	Rankings	1	2	2	2	1.75
C	Ratings	5	7	6	9	27
	Rankings	3	4	4	3	3.5
D	Ratings	5	7	8	9	29
	Rankings	4	5	3	4	4
E	Ratings	5	7	5	9	26
	Rankings	5	3	5	5	4.5

As both the supervisors and operatives of company C were to be included in the next stage of the congruence audit - the individual interviews - it was decided that the firm's systems would be identified during the next monthly production

Figure 6.16: Company C's manufacturing missions as prioritised by the management group



meeting, rather than at the end of the discussion. Doing this meant that the managing director, the production manager, and all the supervisors, would all be able to participate in the process. In addition it also provided an opportunity for the author to review the manufacturing missions with the managing director before the systems used to induce behaviour consistent with them were identified.

6.2.2: **Discussion with managing director - company C**

Prior to the group discussion the managing director had suggested that it might be better if he did not attend the meeting as his presence might have inhibited the rest of the management team. Hence it was agreed that the manufacturing missions would first be defined and prioritised, and then verified by the managing director. Company C has a very flat organisational hierarchy and no manufacturing director. It was therefore important that the managing director played some part in the definition of the manufacturing missions as this ensured that someone who was primarily concerned with strategic issues was involved in the process.

As table 6.2 shows on reviewing the manufacturing missions the managing director made three changes. First he redefined mission C so that it focussed on the minimisation of total and not simply direct labour cost. Second he deleted mission D because he felt that although it was important it was not a mission for the manufacturing function. Third he added a new mission - one which related to teamwork. The fact that these changes were made immediately raised two issues. First there was the question of whose missions were the right ones - i.e. whose should be used in the remainder of the audit? Second there was the question of why these differences of opinion existed.

The first of these questions was relatively easy to answer. As mentioned earlier company C had a very flat organisational hierarchy and no manufacturing director. The managing director was the firm's principal strategist and hence it was decided to use the manufacturing missions that he had defined in the remainder of the study. The answer to the second question was more complex. The first change - replacing direct cost by indirect cost - was understandable and a relatively minor one. The second change - deleting manufacturing mission D was also logical. The managing director saw mission D not as a manufacturing mission - manufacturing had little or no control over whether the materials that provided the highest added value were used - but as a commercial or contracts mission. And indeed one of the more dominant participants in the management group discussion was the contracts manager. Hence perhaps the inclusion of this manufacturing mission was due to him adopting a commercial perspective, rather than focussing on what manufacturing actually had to, and in fact could, do. The reason for the third change - the inclusion of a manufacturing mission that related to teamwork - was similar. As shown in figure 6.12 the management group identified "improve cohesion" as one of the company objectives, however, they did not see this primarily as manufacturing's role. The managing director, on the other hand, recognised that the majority of the firm's resources were part of the manufacturing function and hence felt that if he could stimulate teamwork in manufacturing it would spread through the organisation. In answer to the second question, then, the differences appear to have been due to confusion over whether specific tasks were primarily the role of manufacturing.

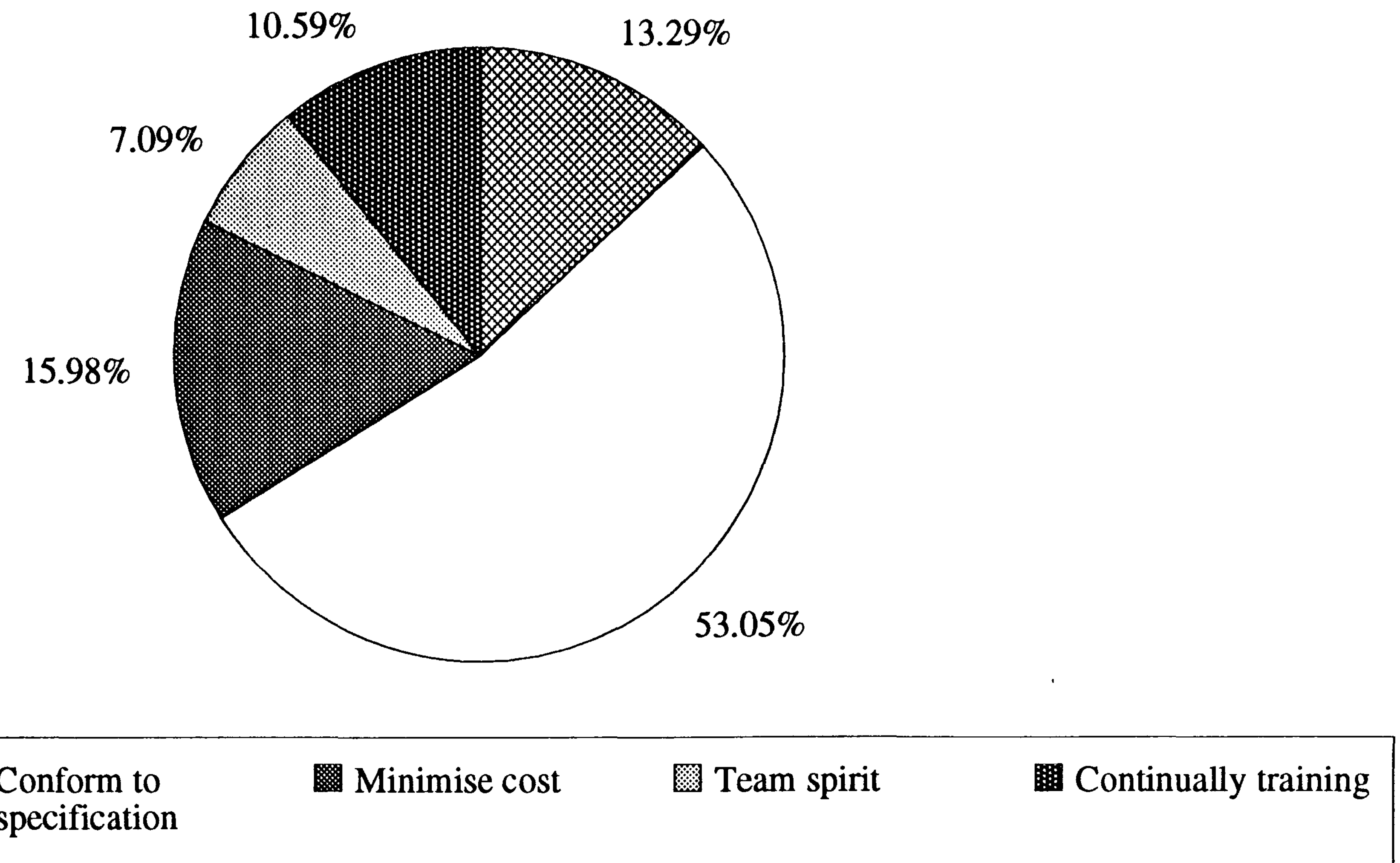
The definition of company C's manufacturing missions raises another interesting issue a it can be argued that missions D (teamwork) and E (training) are not manufacturing missions at all. Indeed the traditional model of manufacturing strategy is based on the assumption that the manufacturing task, and hence the manufacturing missions, state **what** manufacturing has to do. While the manufacturing policies state **how** it will do it. According to the traditional model missions D and E, then, are really policies. In the case of company C, however, they had been elevated to the status of manufacturing missions because they were concrete policies. That is, it had been decided that manufacturing must continually train the work force (mission E) and try to generate a team spirit (mission D), in the same way as it had been decided that manufacturing must deliver high quality (mission B) products when promised (mission A) and minimise the cost base (mission C). This distinction between the manufacturing task and the policy decisions will be explored more fully in chapter 7.

Table 6.2: Manufacturing missions as redefined by the managing director

Manufacturing Missions	Definitions
A	Products must be delivered on time.
B	Products must be made so that they conform to the drawing specification the first time.
C	Products must be made with the minimum cost.
D	A team spirit should be encouraged and maintained within the work force.
E	Employees should constantly be trained so that they have the ability to do a variety of jobs.

As the manufacturing missions defined by the managing director were going to be used for the remainder of the audit the managing director was asked to prioritise them using Saaty's pairwise comparison process. Figure 6.17 shows the resultant pie chart. The data this contains suggest that one of the primary roles of company C's manufacturing function was to produce products which conformed to the specification (mission B). At the end of February 1992 the quality coordinator conducted an internal audit in which he examined company C's outgoing product quality. When the results of that study were made public

Figure 6.17: Manufacturing missions as prioritised by the managing director of company C



the managing director commented "in section 3 of [the] report, out of 12 projects inspected, there are only 3 which have nil percent defects, there are a number where the percentage defects varies between 4% and 50% and even 100% on one occasion - this is disgraceful".

It appears, then, that in early 1992, company C was not realising its manufacturing strategy. As will be seen, the interviews detailed in section 6.2.4, which were completed prior to the publication of the quality coordinator's study, identify some of the reasons why this was the case.

6.2.3: **Production meeting - company C**

Table 6.3 shows the systems that were identified as reinforcing the importance of the manufacturing missions during company C's monthly production meeting. Although the routing card system was primarily used for production control, it also emphasised the importance of producing products which conformed to the specification because before any job could be passed on it had to be signed it off on a routing card. The factory call off requirements sheet was equivalent to a production schedule and reinforced the importance of meeting delivery promises. The cost report, which documented the cost of each job, was only ever circulated when a job had made a loss. Hence it highlighted the importance of minimising the cost base. With the exception of the monthly and weekly production meetings, the remaining formal systems were reward based. The Xmas bonus (turkey) refers to the turkey which was given to each employee at Christmas. The supervisor's annual cash bonus was a variable and one-off discretionary payment which the managing director made to individual managers. The operative's guaranteed bonus was a union negotiated bonus and was awarded to all employees who worked in the construction industry. The plus rate was a merit award consolidated into the operative's weekly pay. The spot bonus was a discretionary payment of approximately £10 which supervisors were allowed to award individuals on a weekly basis. Once these systems had been identified all the data required for the individual interviews were available. The next section describes these interviews.

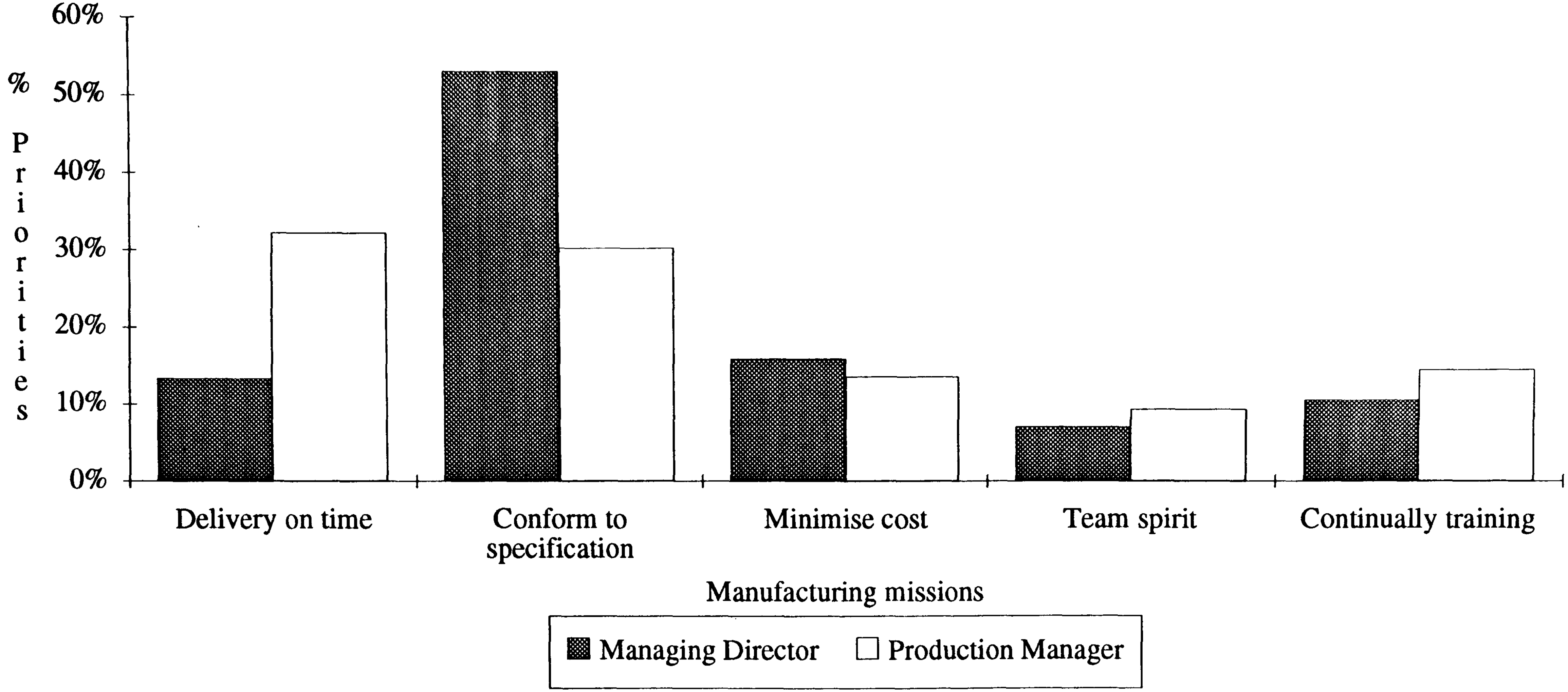
Table 6.3: Systems used to reinforce the importance of the missions - company C

	Systems applying to the foreman	Systems applying to the operatives
Goal Setting	Routing card Mthly prod meeting Wkly prod meeting Factory call off requirements sheet	Routing card
Performance Measurement	Cost report	
Feedback	Informal feedback on performance	Informal feedback on performance
Reward	Basic salary Xmas bonus (turkey) Annual cash bonus	Basic weekly salary Guaranteed bonus Plus rate Spot bonus Xmas bonus (turkey)

6.2.4: Individual interviews - company C

The first person to be interviewed was the production manager. Figure 6.18 compares the way in which he and the managing director prioritised the manufacturing missions. The chart was drawn during the interview and shown to the production manager. Initially he expressed surprise at the differences in opinion. Then he said that the managing director's actions were inconsistent with his prioritisations. When prompted for more information the production manager explained that whenever the managing director came onto the shop floor he asked about the schedule and not quality, and hence he couldn't understand how the managing director could claim to care so much about quality.

Figure 6.18: Priorities of the managing director and the production manager - company C



Following this four first line supervisors and nine operatives were interviewed. Of these, one of the interviews with one of the operatives was aborted because, despite repeated probing, the consistency ratio (see Appendix II) generated during the pairwise comparison process remained extremely poor. Figures 6.19 through to 6.30 show the data that were collected during each interview. The comments below summarise the reasons offered by each interviewee when asked to explain any major discrepancies between their prioritisations and:

(a) Those of the managing director.

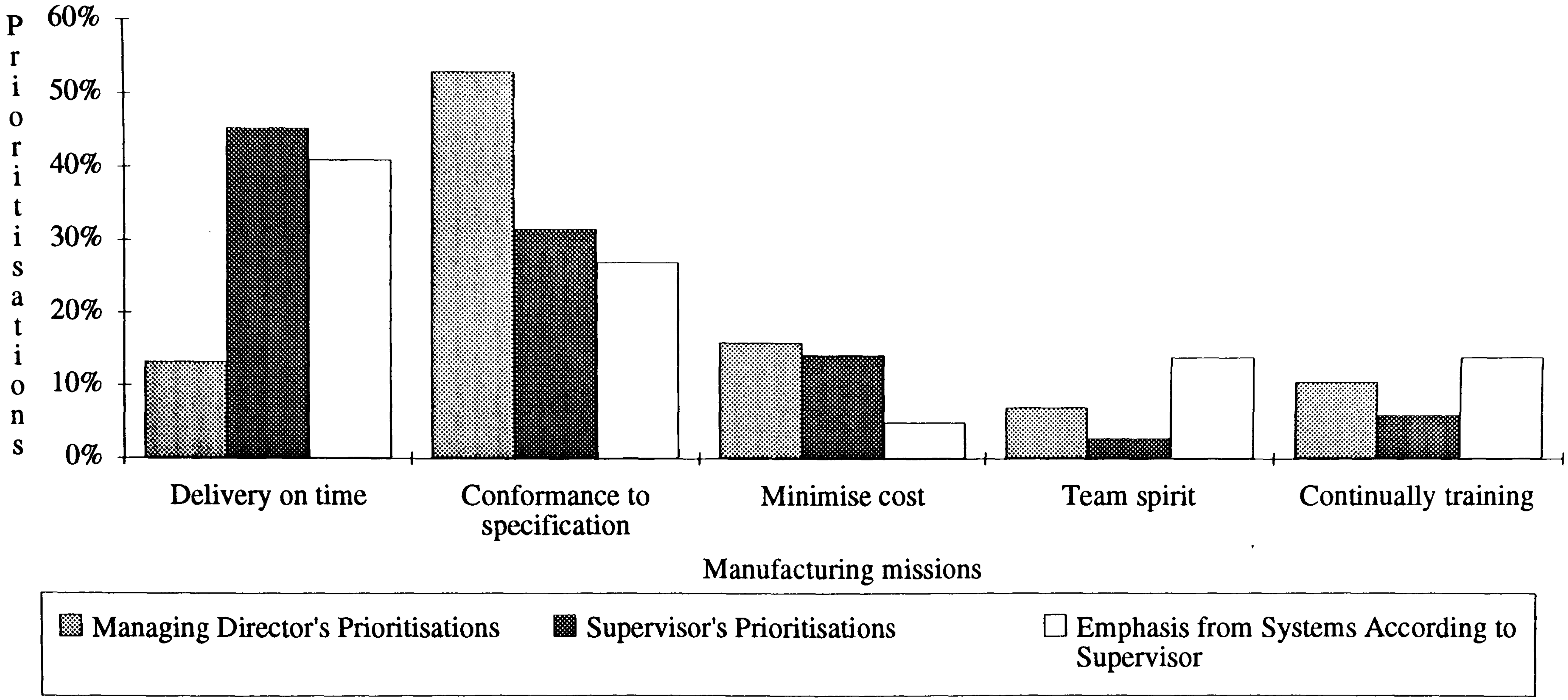
(b) The extent to which the systems they were subject to induced decision making and action consistent with the manufacturing missions.

Figure 6.19 - supervisor 1

Figure 6.19 shows that supervisor 1 believed that manufacturing mission A (delivery) was far more important than the managing director. When asked if he could offer any reasons why this might be the case he explained that he was in charge of the first manufacturing operation and was very conscious that if he fell behind schedule he would hold up the rest of the shop. Similarly figure 6.19 shows that supervisor 1 saw manufacturing mission B (quality) as much less important than the managing director. He argued that this was because some jobs were overspecified and his experience told him that he could often safely ignore the specifications. As an example, he explained that although it was company policy to scrap a piece of wood if it was knotted, it was possible to ensure that the knot would never be seen by using it on the underside of a bench or table.

With regard to the systems figure 6.19 shows that supervisor 1 places more emphasis on the minimisation of cost than might be expected and less on manufacturing missions D (team spirit) and E (training). When asked why he thought cost was so important he replied; cost minimisation is part of the job. Neil (the production manager) likes it when I identify ways in which we can do things more quickly and cheaply. Similarly when asked to explain why he thought missions D and E were less important than the systems suggested he

Figure 6.19: Data gathered during the interview with supervisor 1 - company C



said; for the business to survive you have to get everything else right first.

Figure 6.20 - supervisor 2

Figure 6.20 shows that supervisor 2 also believes that delivery on time was far more important than the managing director and that quality was far less important. When asked why he thought these differences of opinion existed supervisor 2 said that he was surprised at Alan's (the managing director) prioritisations because he always appeared to push for delivery, even if it was at the expense of quality.

With regard to the systems figure 6.20 shows that supervisor 2 placed more emphasis on delivery than might be expected and less on team spirit and training. When asked why he explained that both the production and contracts managers focussed on due dates. Hence delivery performance had to take precedence. As for team spirit and training, the former was expected and so he paid little attention to it, while he did not think the latter was taken particularly seriously in company C.

Figure 6.21 - supervisor 3

Figure 6.21 shows that the main difference in terms of priorities between supervisor 3 and the managing director was with regard to manufacturing mission C (minimise cost). When asked why he thought this was the case supervisor 3 explained that he paid a lot of attention to the cost reports. In fact during the entire interview supervisor 3 appeared to be very financially motivated. According to the pairwise comparison the systems that influenced his behaviour most were; his basic salary (28%), the annual cash bonus (25%) and the cost report (18%).

As with the previous two interviewees, supervisor 3 placed less emphasis on manufacturing mission D (team spirit) than might be expected given how much he thought the firm's systems emphasised it. When asked why he said; because you have to get the first three missions right first.

Figure 6.20: Data gathered during the interview with supervisor 2 - company C

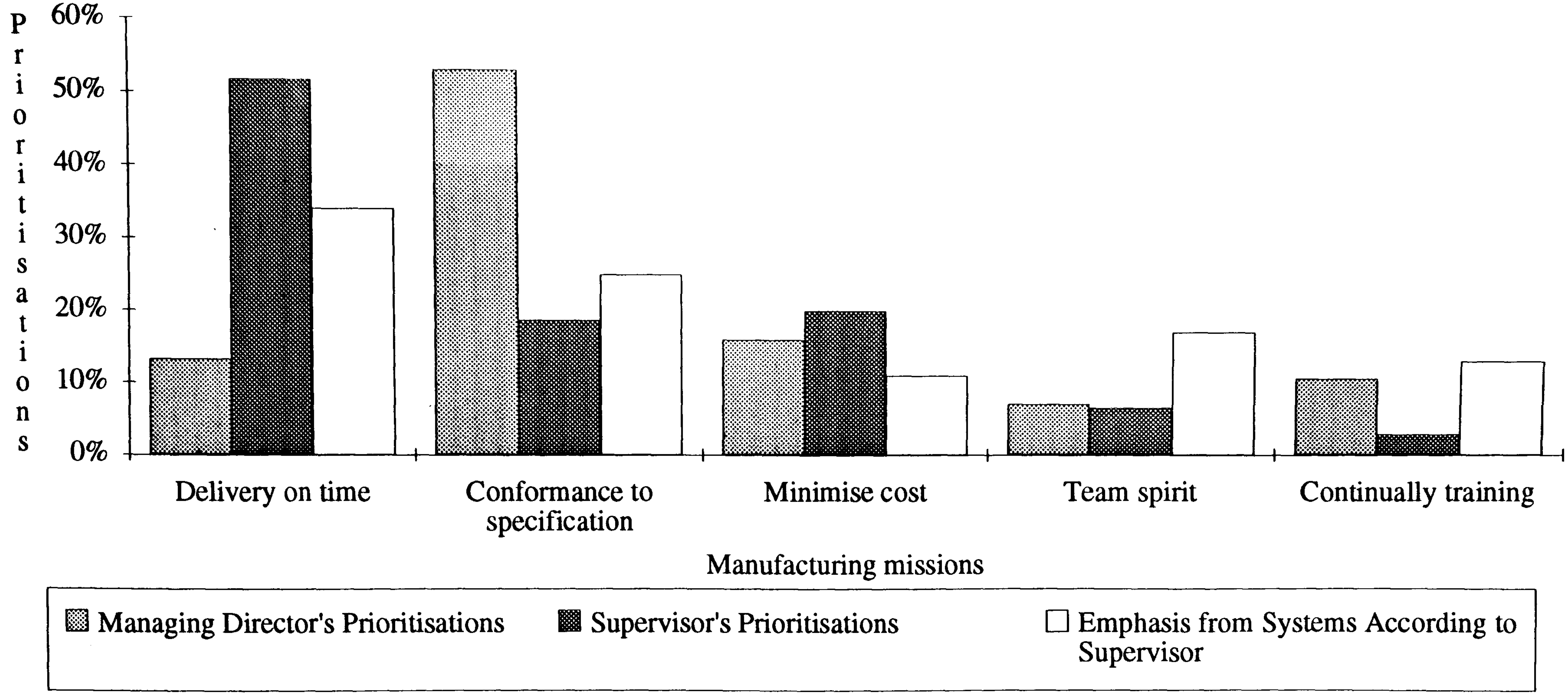


Figure 6.21: Data gathered during the interview with supervisor 3 - company C

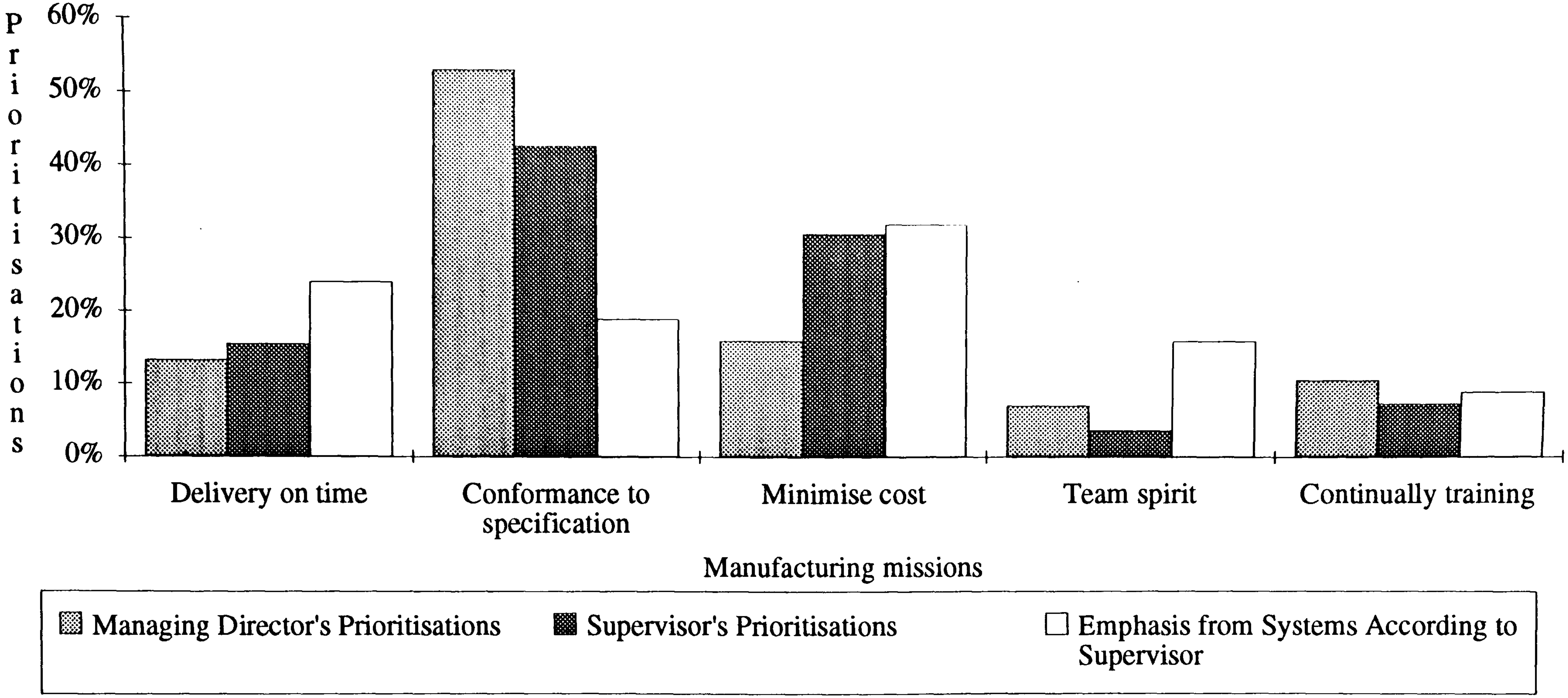


Figure 6.22 - supervisor 4

Figure 6.22 shows that supervisor 4 thought that quality was more important than the managing director. When asked if he could think of any reasons to explain this supervisor 4 said that he was surprised that Alan (the managing director) had rated mission B so highly because he always "ranted and raved about getting the product out of the door and not about quality".

Figure 6.22 also shows that supervisor 4 prioritised training more highly than the managing director and indeed he was the only supervisor to do this. When asked why he thought this was the case he said that he was strongly in favour of training and had raised it at a number of production meetings because he saw it as a prerequisite to achieving high product quality. It should be noted that supervisor 4 was responsible for managing company C's specialist joinery department where the jobs with the most exacting specifications were completed.

With regard to the systems supervisor 4 put more emphasis on quality and less on delivery and cost minimisation than might be expected. His reason for this follows on from the point made previously. That is, supervisor 4 said he was primarily concerned with making "perfect" products and he could not "give a toss" if that meant that they cost too much or he had to deliver them late.

Figure 6.23 - operative 1

Figure 6.23 shows that operative 1 believed that manufacturing missions A (delivery) and D (team spirit) were more important than the managing director, while B (quality) and E (training) were less important. When asked why he thought these differences of opinion existed operative 1 said that he believed that delivery was important because company C was subject to penalty clauses on many of its contracts and hence the foreman would often come and ask when a particular job would be ready. With regard to team spirit and training, operative 1 said that the former was important because it helped get jobs done, but that he ignored the latter because he was no longer an apprentice.

Figure 6.22: Data gathered during the interview with supervisor 4 - company C

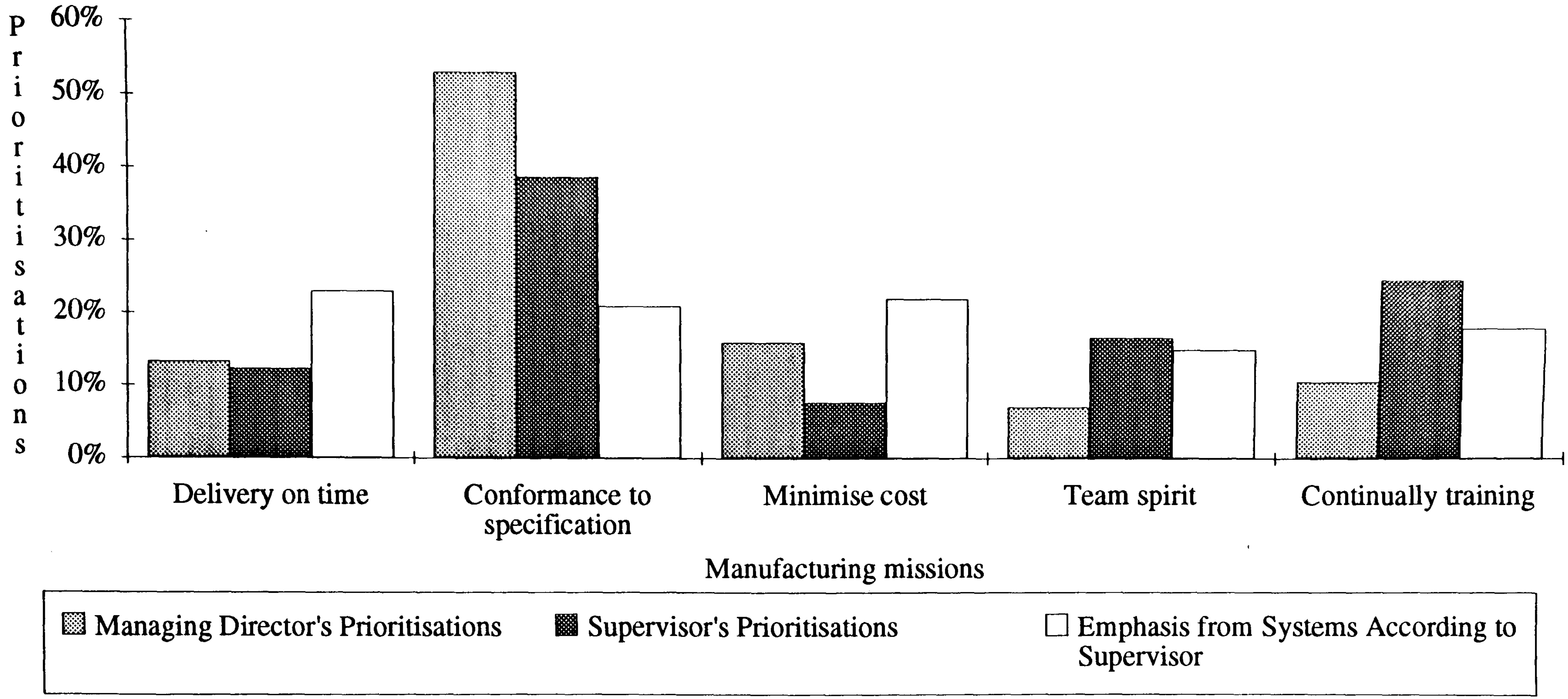
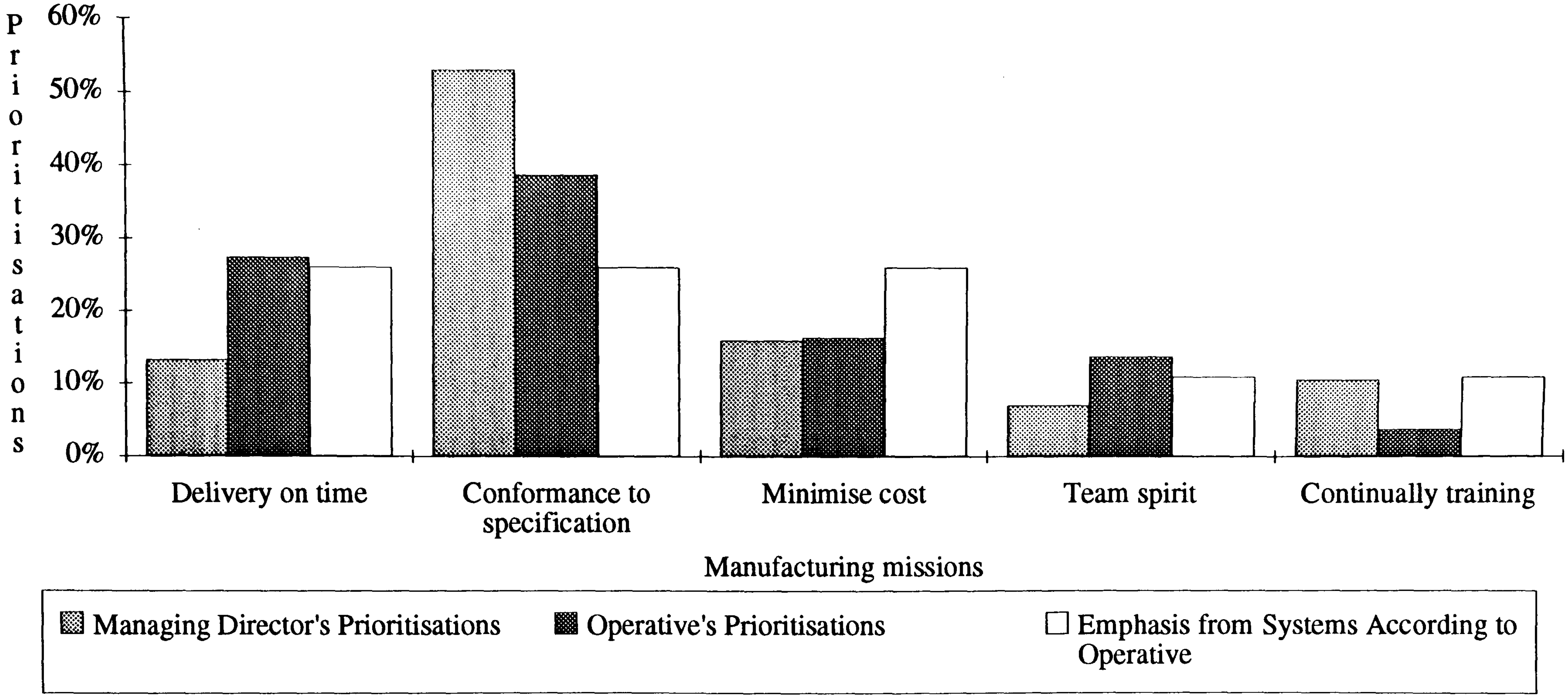


Figure 6.23: Data gathered during the interview with operative 1 - company C



For operative 1 quality was an interesting issue because although he saw it as less important than the managing director, he placed more emphasis on it than might be expected from the systems. When asked why, operative 1 explained that he thought quality was important because if you got it right then everything else, including cost, fell into place. In addition he said that he knew that Alan (the managing director) cared about quality because when he had been working on company C's new office block Alan had frequently visited the site to check that everyone was doing a good job.

Figure 6.24 - operative 2

Figure 6.24 shows that operative 2's priorities were virtually the same as those of the managing director. The major questions that remained, however, were; (a) why did operative 2 believe that quality was so important given that he thought the firm's systems placed so little emphasis on it, and (b) why did he think that missions C (minimise cost) and D (team spirit) were so unimportant given that he believed that the systems placed so much emphasis on them? In response to the first of these questions operative 2 said that he thought that if the firm provided high quality products it would get a good reputation in the market place and therefore win more orders. In response to the second he said that he would spend extra time and money on a job to ensure it was of high quality. Operative 2, however, could not explain why he thought team spirit was so unimportant.

Figure 6.25 - operative 3

Figure 6.25 shows that the main difference between the operative's and managing director's prioritisations were with regard to manufacturing missions A (delivery) and B (quality). In response to the question; "why do you think you place more emphasis on delivery than the managing director", operative 3 explained that he saw a lot of routing cards which had due dates on them and hence he knew that on time delivery was important.

As with operative 1, quality for operative 3 was an interesting issue because

Figure 6.24: Data gathered during the interview with operative 2 - company C

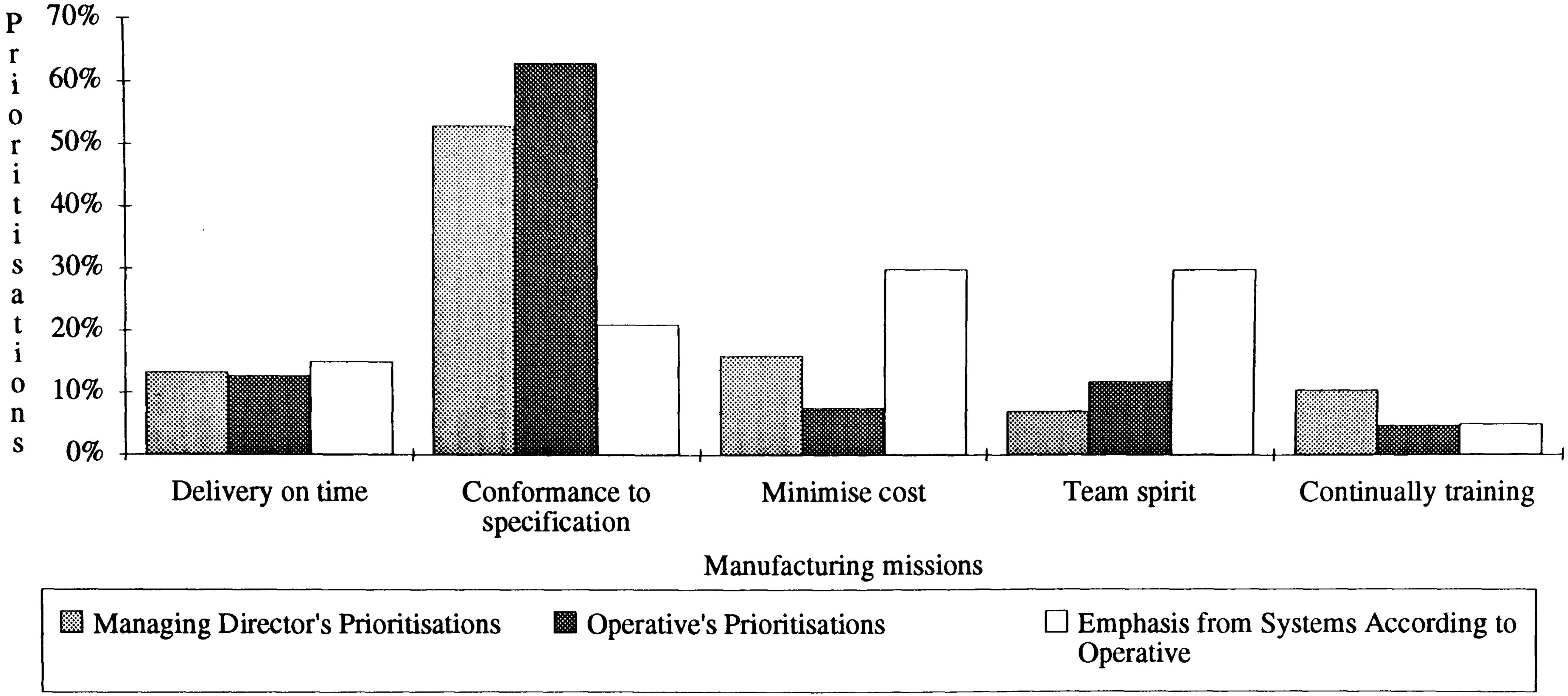
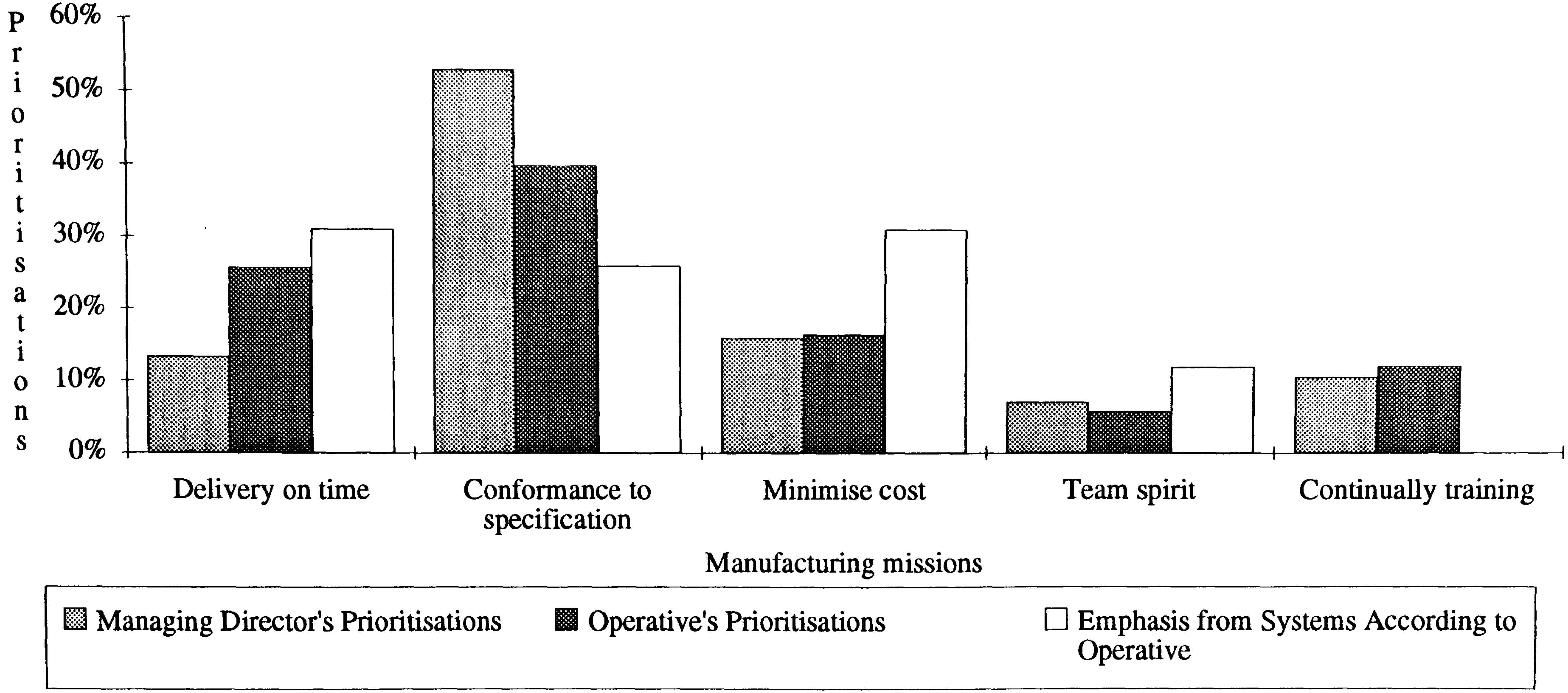


Figure 6.25: Data gathered during the interview with operative 3 - company C



although he saw it as less important than the managing director he placed more emphasis on it than might be expected. When asked why he said that he believed that by getting the quality of the product right you not only satisfied the customer, but also reduced the cost. With regard to mission E operative 3 said that he did not think that any of the firm's systems emphasised the importance of training, but even so he was conscious that it was necessary.

Figure 6.26 - operative 4

Figure 6.26 shows that once again the operative's and managing director's prioritisations were very similar. With regard to the systems the main discrepancy was over quality. When asked why he thought quality was so important operative 4 explained that his philosophy was that if you make the job exactly as the drawing says then you can not be blamed if something goes wrong. It should be noted operative 4 had recently been made redundant by his previous employer and had only been with company C for two months. Hence his philosophy may have been driven largely by a natural desire to protect both himself and his job.

Figure 6.27 - operative 5

Operative 5 experienced more difficult than the remainder of the sample explaining why the differences in priorities shown in figure 6.27 existed. Basically his thesis was that delivery and quality were the key choices for the customer and hence they must be of approximately equal importance, but he was unable to provide any further explanations for his opinions.

Figure 6.28 - operative 7

Operative 7 believed that most of the firm's systems placed some emphasis on the importance of training and this explains the major discrepancy with regard to manufacturing mission E. It should be noted, however, that operative 7 had just finished a three year apprenticeship and had probably been subject to continual stimuli emphasising the importance of training. Indeed when asked what he now needed most, he said; "experience, not more training".

Figure 6.26: Data gathered during the interview with operative 4 - company C

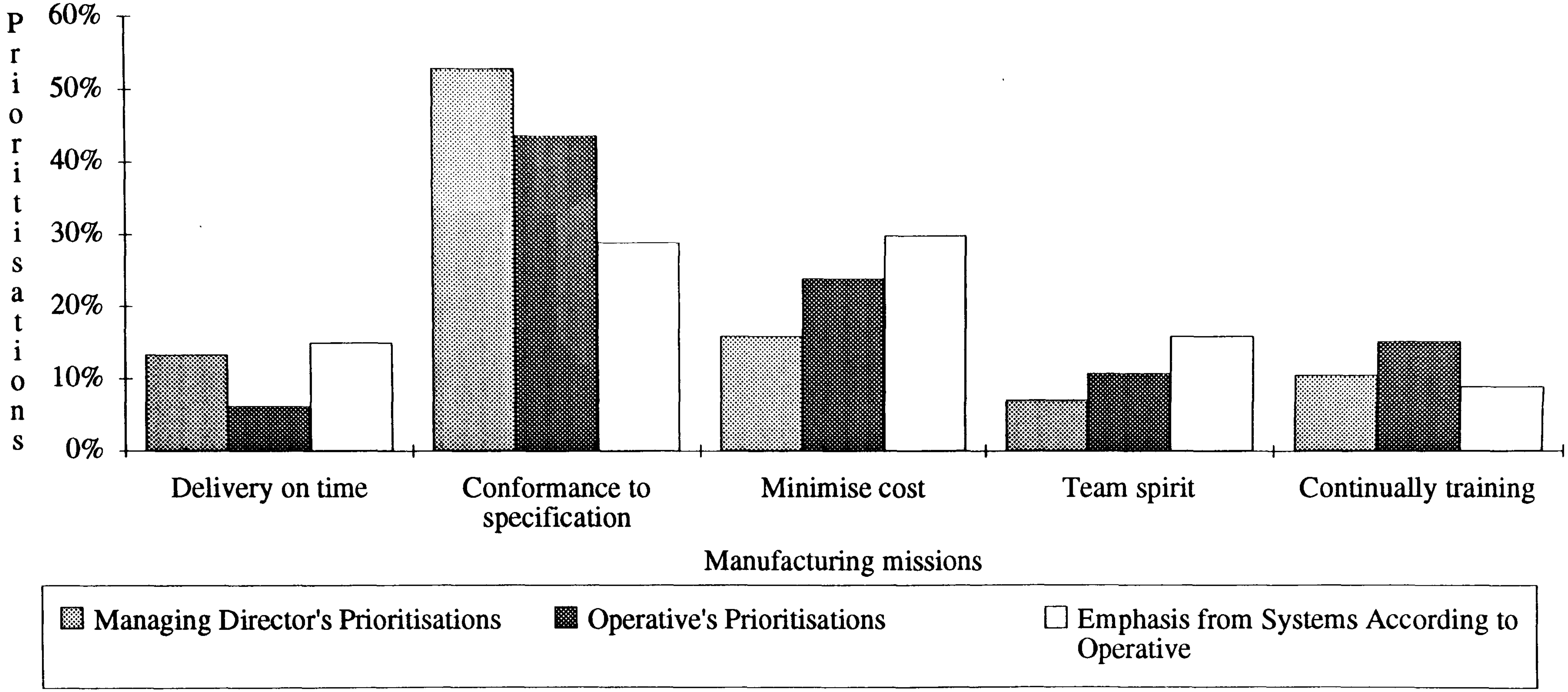


Figure 6.27: Data gathered during the interview with operative 5 - company C

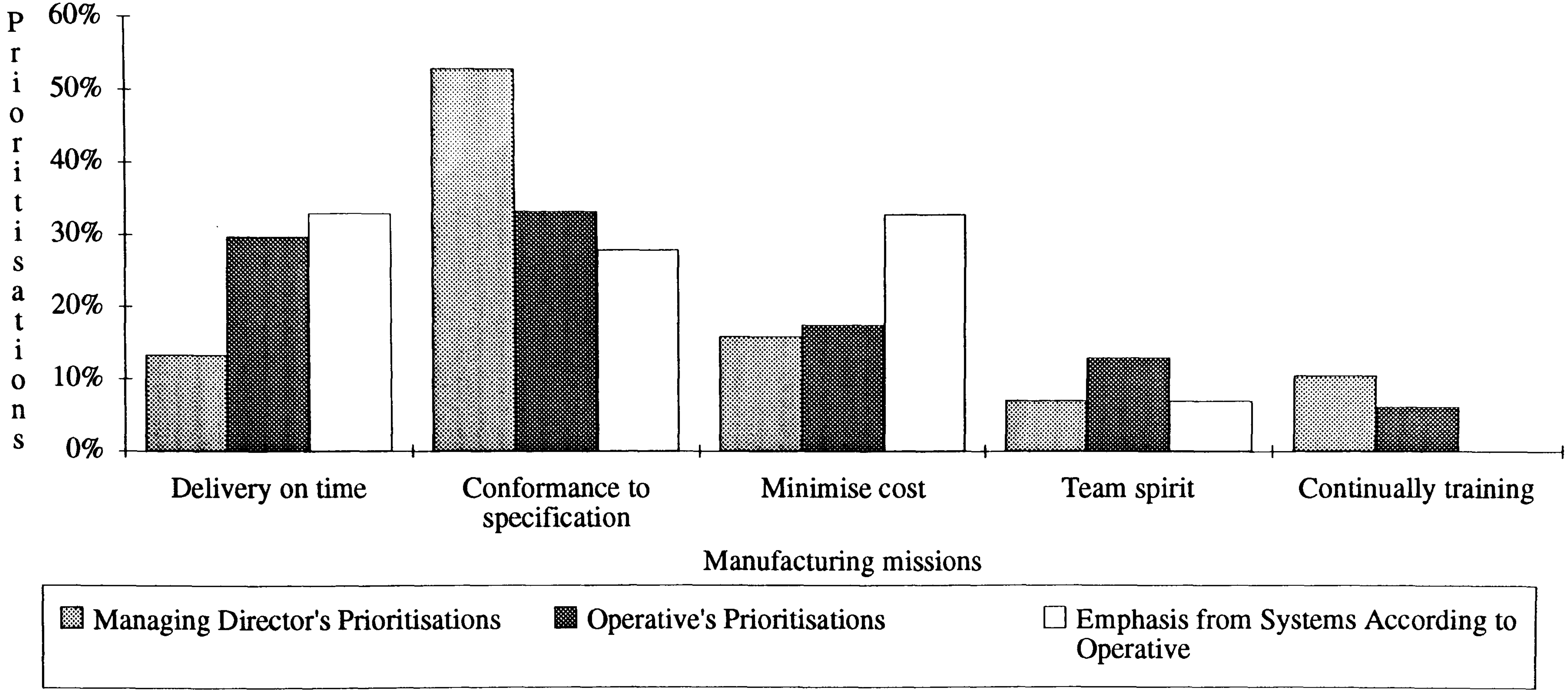
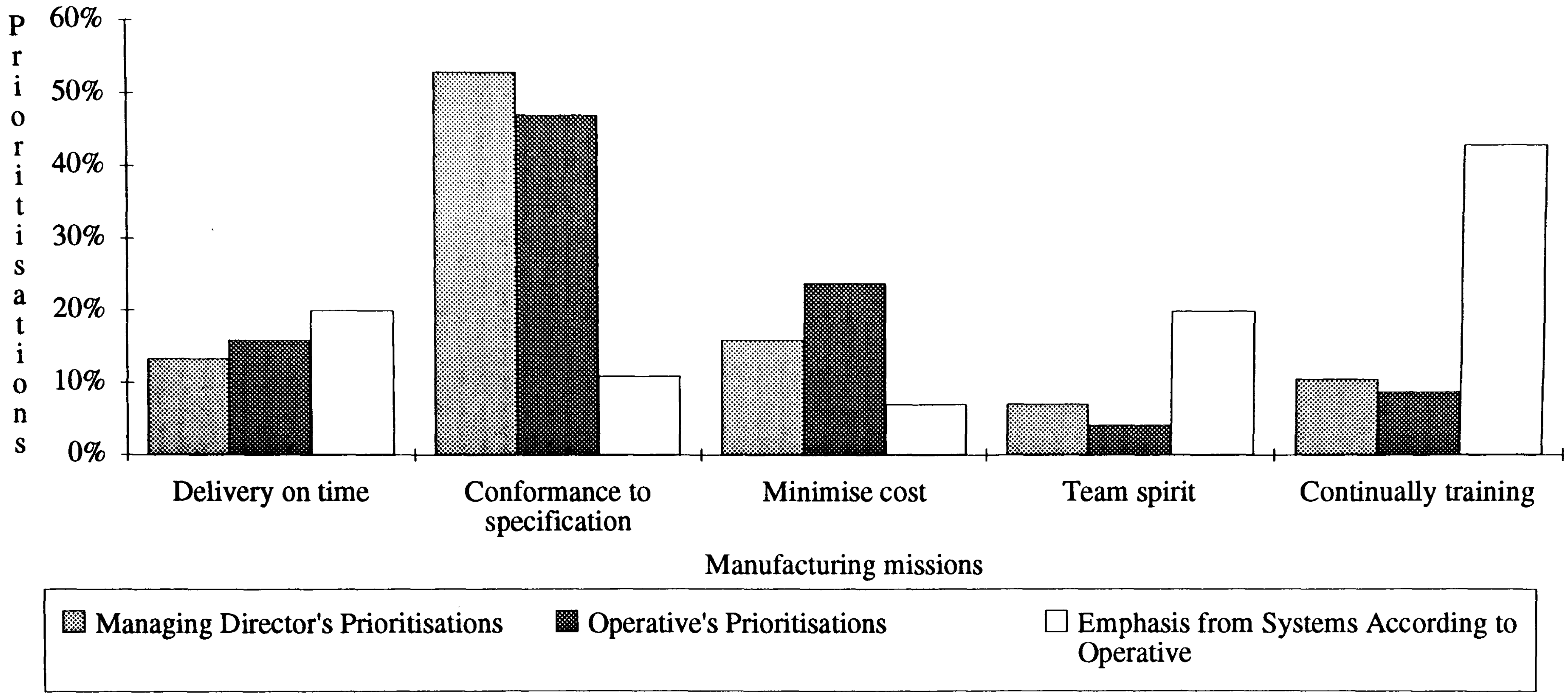


Figure 6.28: Data gathered during the interview with operative 7 - company C



The other major discrepancy shown on figure 6.28 was with regard to quality. Operative 7 said that the firm's systems put very little emphasis on quality, but still he saw it as very important. When asked why he explained that he had recently received a written warning because he was not producing products of an appropriate quality. Operative 7 was also asked to explain why he thought the systems emphasised team spirit so much. In response he said that a number of new people had recently joined his section and hence his supervisor had spent a lot of time talking about team spirit. In addition operative 7's pay had been reduced by the discontinuation of his plus rate because it was thought that he had not been contributing to the team. He therefore believed that there was a strong correlation between team work and bonus payments.

Figure 6.29 - operative 8

Figure 6.29 shows that the main differences of opinion between the managing director and operative 8 were with regard to delivery and quality. When asked why he thought this was the case operative 8 said that it was probably a functional difference. He pointed out that he was about to become a manager and currently came under a lot of pressure from the production manager to ensure that he was meeting the delivery schedule.

With regard to the systems figure 6.29 shows that operative 8 believes that team spirit is more important than might be expected, while training is less important. Operative 8 was unable to explain either of these discrepancies, although it should be noted that he was doing an HNC at the time and hence it was not surprising that he received a lot of stimuli reinforcing the importance of training.

Figure 6.30 - operative 9

Figure 6.30 shows that the major discrepancies between operative 9's prioritisations and those of the managing director were with regard to quality. When asked if he could explain why this might be operative 9 said that his supervisor emphasised delivery at the expense of quality through the spot bonus system. That is, spot bonuses were only paid when a rush job had been

Figure 6.29: Data gathered during the interview with operative 8 - company C

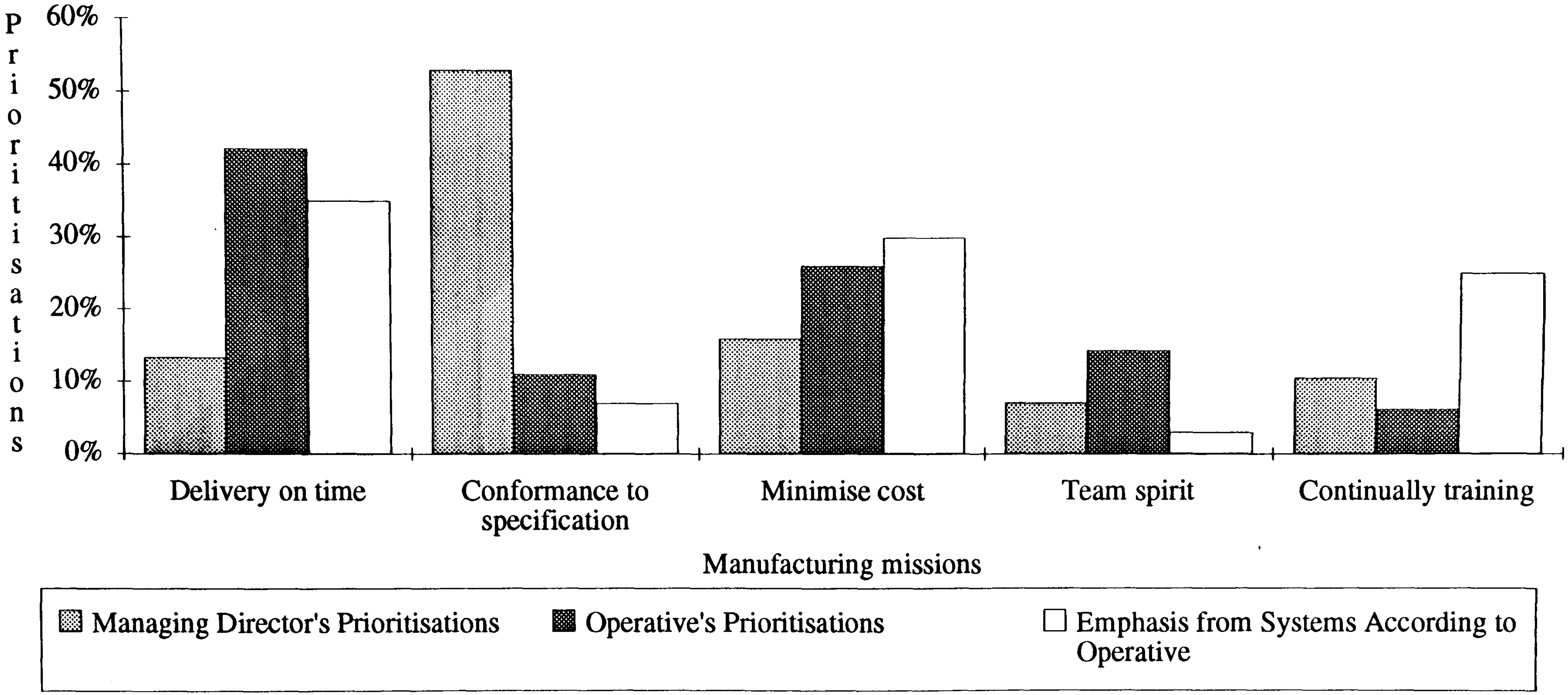
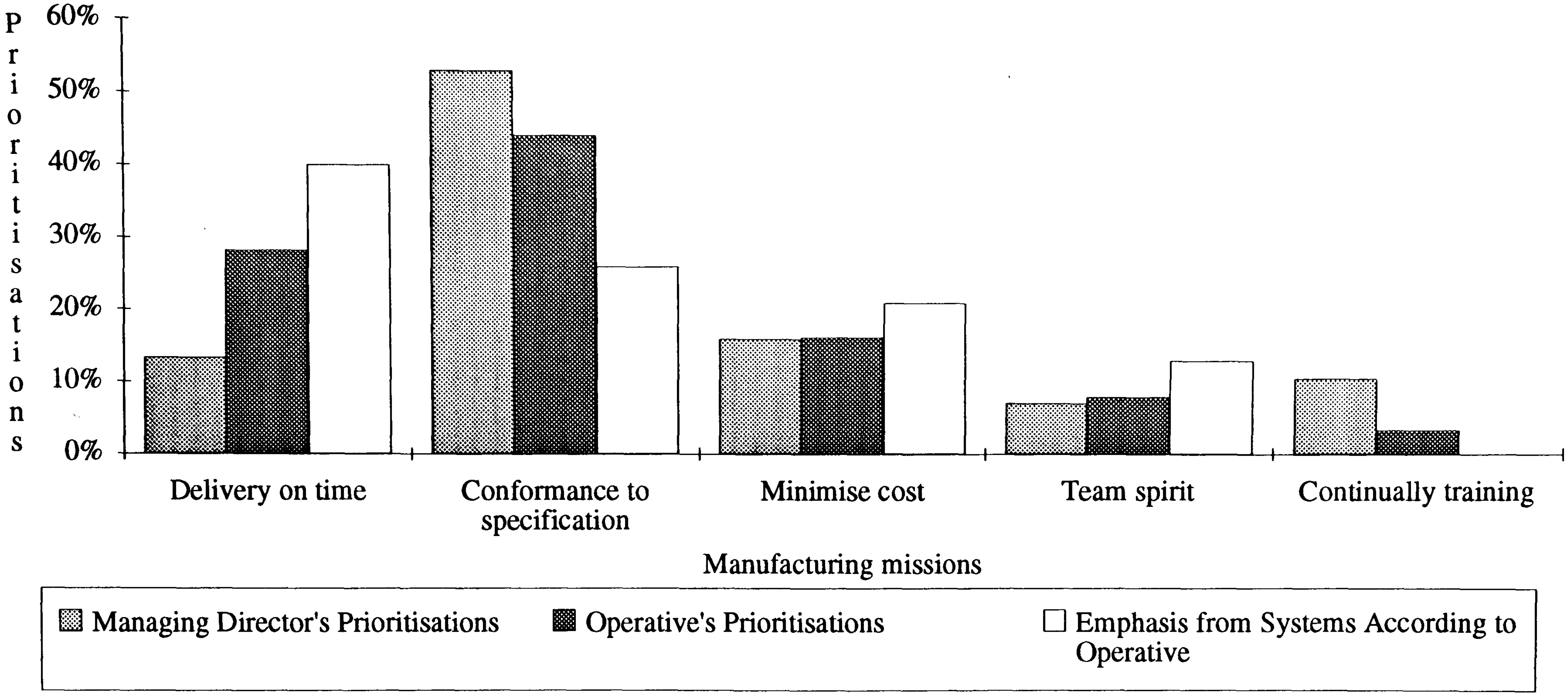


Figure 6.30: Data gathered during the interview with operative 9 - company C



completed. It should also be noted that the pairwise comparisons showed that the spot bonus system influenced operative 9 far more than anything else (45%). Hence as he related payment of a spot bonus to delivery rather than quality, it is not surprising that the systems appear to over emphasise delivery and under emphasise quality.

Figures 6.31 through to 6.33 present aggregate versions of these data. The first shows how the various groups of interviewees at the different levels of the organisation's hierarchy prioritised the five manufacturing missions. There are two points to note about this chart. First the level of goal congruence appears to be highest between the managing director and the operatives as a group. Second the major area of dispute is with regard to the manufacturing missions; (a) products must be delivered on time and (b) products must be made so that they conform to the drawing specification the first time. As has been seen a number of the individual interviewees, especially the production manager and supervisors, commented that the managing director's profile seemed wrong. That is, he claimed that the most important manufacturing mission was producing products which conformed to the specification and yet his daily actions suggested that what he really cared about was delivering the products when promised.

Figures 6.32 and 6.33 show what the supervisors and operatives believed the systems emphasised. As in figure 6.31 the data shown are the average values for the groups. Figure 6.32 suggests that the importance of delivering products on time was strongly emphasised at the weekly production meeting which was chaired by the production manager. Interestingly the routing card system, which was supposed to act as a production control device, actually placed more emphasis on "conformance to specification" than it did on "delivery on time". During the discussions at the end of the interviews two reasons for this emerged. Firstly due dates were rarely recorded on the routing cards and even when they were they were often wrong. Second the managers had to sign off each job on its routing card before it could be passed on to the next department.

Figure 6.31: Prioritisations of company C's manufacturing missions

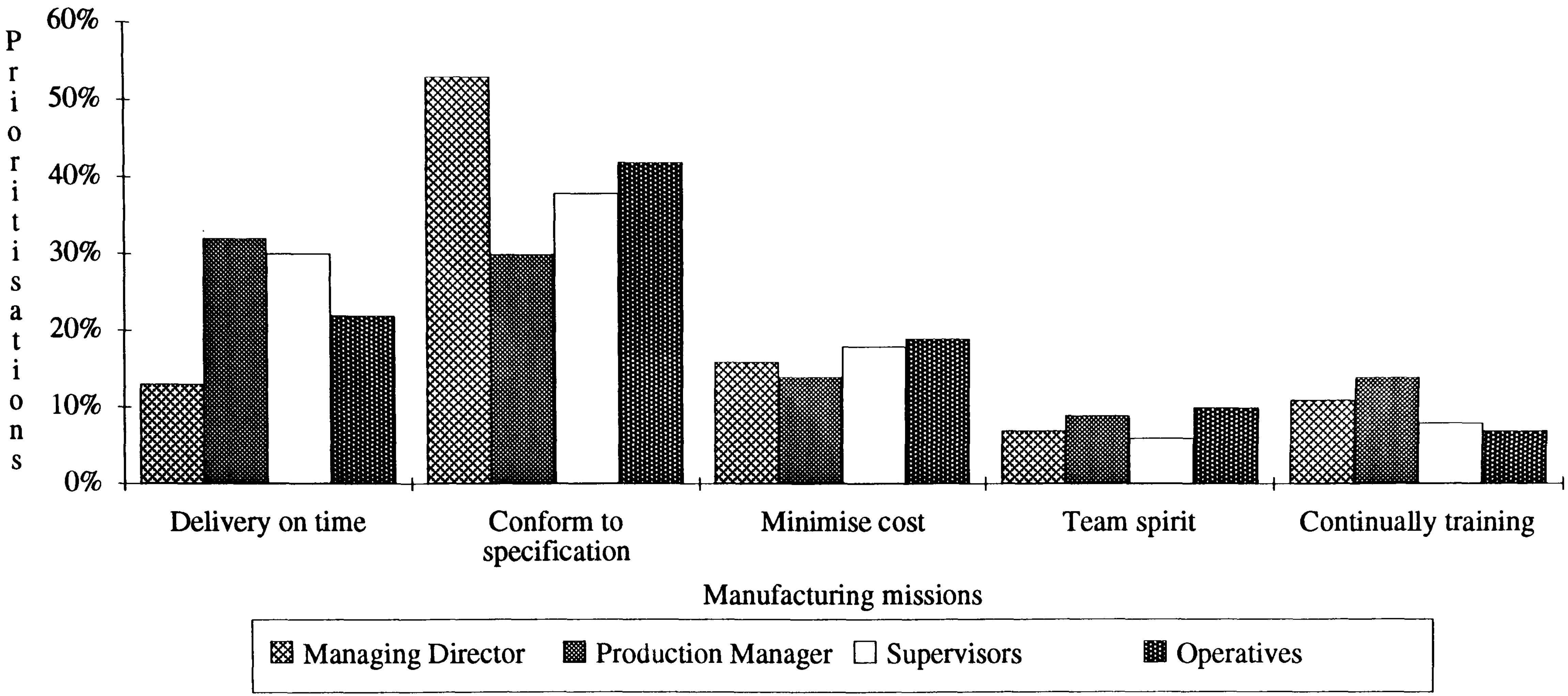
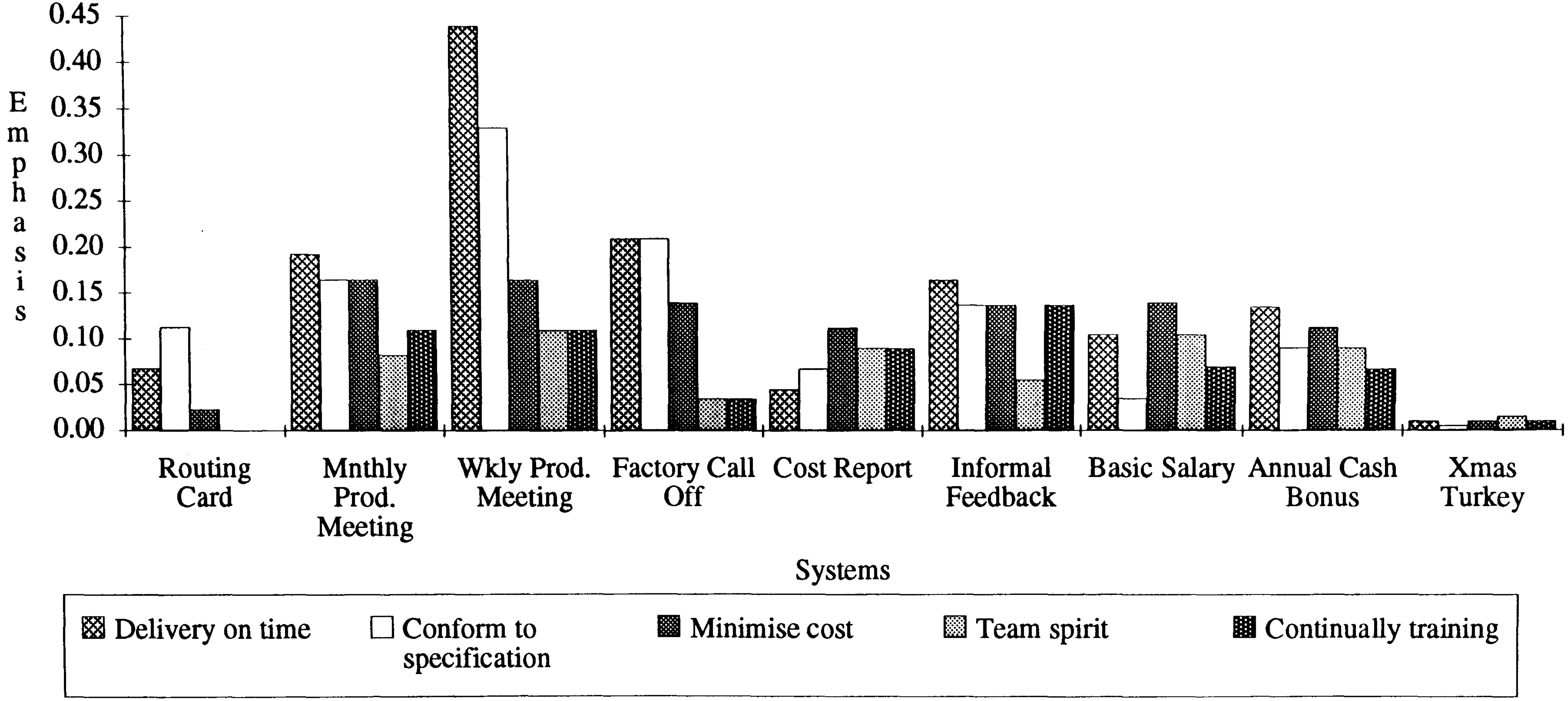


Figure 6.32: What the supervisors as a group believe the systems emphasise - company C

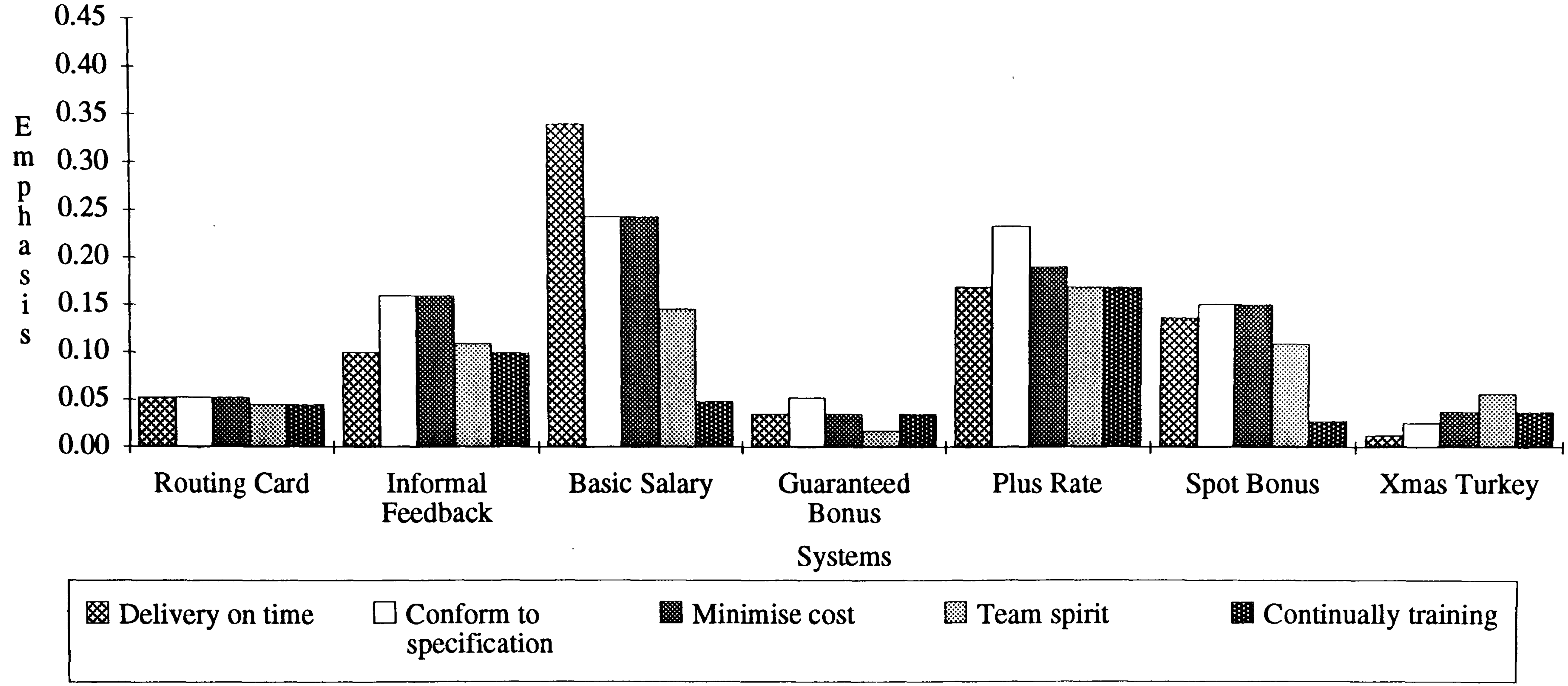


So, although the routing card system had been designed as a production control tool it was actually being used to monitor quality.

Figure 6.33 shows that the operatives related their basic salary most closely to manufacturing mission A, delivery on time. This may be because they linked the delivery of a product to the fact that the company was still winning orders and hence would be able to pay their wages. Two points, however, should be noted about this chart. First the operatives appear to have been less influenced by the firm's non-financial systems than the supervisors. Second when asked to say which system influenced their actions the majority of the operatives rationalised their answer by saying; "my basic salary is worth more to me than the spot bonus, therefore my basic salary must influence my actions more". It is was if the operatives in company C had been motivated by financial rewards for so long that they had become like Pavlov's dogs. The more they were offered, in financial terms, the higher they jumped.

In summary, then, it would appear that the production manager communicated to the supervisors the fact that he believed that delivery on time was the most important manufacturing mission primarily through the weekly production meeting. The supervisors acknowledged this message, but because they were subject to other systems realised that other things, such as quality were important. The operatives, who are one step removed from the production manager, paid less attention to the systems, especially the non-financial ones. Interestingly this meant that their prioritisations more closely matched those of the managing director. Hence the key problem in company C appeared to be communication between the managing director and the production manager. That is the managing director was sending the production manager signals which said "delivery on time is important" and the production manager, in turn, was trying to push this message down through the firm. This resulted in a prevailing attitude which one of the interviewees summed up by saying; "we'll often rush stuff here. We'll send product out to the customer before we get it right". Even though the managing director believed that the manufacturing

Figure 6.33: What the operatives as a group believe the systems emphasise - company C



strategy the firm should have been pursuing was one based on high product quality.

6.3: **Audit in company D**

Company D designs and manufactures electronic control equipment. It is part of a large U.S. multi-national group and its U.K. manufacturing facility is situated close to Leicester. The congruence audit described in this section was conducted in June 1992. The managers present at the group discussion included the manufacturing director, production manager, personnel manager, planning manager, customer order manager, management accountant, senior systems analyst and one internal customer. Company D supplies product to other parts of the group - hence the production manager had suggested that the presence of an internal customer might be beneficial. Following the group discussion two first line supervisors, eight operatives and two "other" members of staff (one production and one materials controller) were interviewed. In sections 6.3.1 and 6.3.2 the data generated during this case are presented and discussed.

6.3.1: **Management group discussion - company D**

Company D only has one major product family - electronic control units. Hence this provided the focus for the group discussion. Following the brainstorming session the manufacturing missions were defined as shown in table 6.4. It can be seen that company language featured heavily in the definitions. Take, for example, loss prevention. In company D the phrase loss prevention was used to refer not only to "waste elimination" but also to things such as accidents.

Once the manufacturing missions had been defined the individual members of the management group were ask to rank and rate them. The data generated were summarised on a check sheet shown in figure 6.34. Doing this indicated that the biggest area of disagreement was with regard to the importance of loss prevention. The senior systems analyst thought it was the most important manufacturing mission, while both the management accountant and personnel manager thought it was the least important. The next stage of the discussion involved the managers as a group prioritising the missions using Saaty's pairwise comparison process. As expected mission F (loss prevention) was the subject of greatest debate, but figure 6.35 shows it ultimately received a relatively high prioritisation.

Table 6.4: Manufacturing missions defined
by the management group - company D

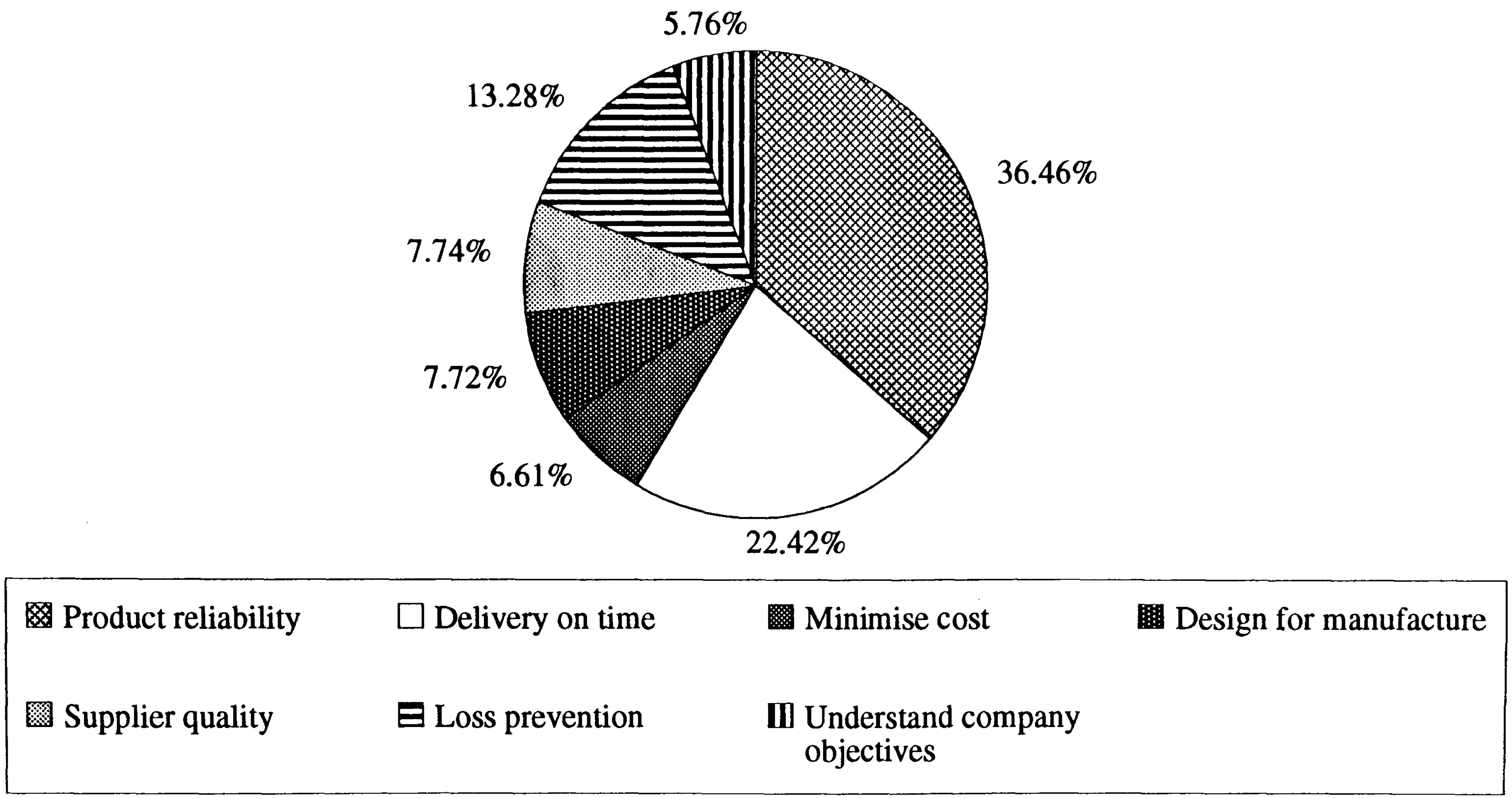
Manufacturing Missions	Definitions
A	Products must work first time and for as long as required.
B	Products must be delivered on time to the customer.
C	Non value added processes and materials must be reduced/eliminated.
D	Design for manufacture.
E	Quality parts must be supplied on time to company D.
F	Loss prevention.
G	People should understand the company objectives.

Figure 6.34: Check sheet used to feedback rankings and ratings

Manufacturing missions		Prod Mgr	Plan Mgr	Pers Mgr	Customer	Manuf Dir	Cust Order	Mgmt Acc	Syst Anal
A	Ratings	8	9	9	9	9	9	9	8
	Rankings	1	1	1	1	1	1	2	2
B	Ratings	9	9	7	9	9	9	7	7
	Rankings	2	3	2	2	2	2	1	3
C	Ratings	8	7	7	7	9	7	5	5
	Rankings	3	4	3	3	6	3	3	6
D	Ratings	7	8	7	5	9	7	5	6
	Rankings	7	5	4	7	4	5	5	5
E	Ratings	7	9	5	5	9	7	5	6
	Rankings	6	2	6	6	7	4	6	4
F	Ratings	7	6	5	5	9	5	5	8
	Rankings	5	6	7	4	3	6	7	1
G	Ratings	8	7	5	5	7	5	5	5
	Rankings	4	7	5	5	7	7	4	7

In the final stage of the group discussion the managers were asked to identify which systems they used to try and ensure that their subordinates acted in a manner which was consistent with the manufacturing missions. To do this the hierarchy of probing questions proposed in section 5.3.1 was used. Table 6.5 summarises the systems that were identified. The management by results system, the formal appraisals and the merit system were all standard systems. The strategy sessions and the manufacturing communications meetings were both chaired by the manufacturing director and involved groups of employees. At the former the employees were invited to give their views as to what the firm's strategy should be. At the later the manufacturing director provided feedback on the company's performance. The quality attribute measurement system consisted of a cascaded set of measures of manufacturing's

Figure 6.35: Manufacturing missions as prioritised by the management group in company D



performance, each of which had been derived from the business strategy. At the monthly quality meetings current quality problems were discussed. At the weekly group/area meetings the head of each section fed back data on the section's performance to its members. Company D also made extensive use of visual feedback and there were a variety of wall charts in each of the manufacturing departments. Similarly all visitors to company D were encouraged to talk to operatives. The production manager specifically asked for a system labelled "visitors" to be included to see what the operatives thought of such conversations.

Table 6.5: Systems used to reinforce the importance of the missions - company D

	Systems applying to the interviewees in company D
Goal setting	Management by results Formal appraisal Strategy sessions
Performance measurement	Quality attribute measurement system
Feedback	Monthly quality meeting Manufacturing communications meeting Group/area meetings Visual measures and notice boards Informal feedback Visitors to company D
Reward	Merit system

Following the management group discussion all the data required for the individual interviews were available. There was no need to review these data as the manufacturing director had been involved in the group discussion and hence the next stage of the investigation - the individual interviews - began.

6.3.2: **Individual Interviews - company D**

As mentioned earlier 12 individual interviews were conducted in company D using the methodology described in section 6.2.1. One of the interviews with one of the operatives was aborted because, despite repeated probing, the consistency ratio generated during the pairwise comparison process remained extremely poor. The data gathered during the remaining 11 interviews are summarised in this section.

Figure 6.36 - supervisor 1

Figure 6.36 shows that the major areas of discrepancy between the priorities of supervisor 1 and the management group were with regard to manufacturing missions A (product reliability), F (loss prevention) and G (understand company objectives). When asked if he could think of any reasons why this should be the case supervisor 1 explained that personal experience had shown him that explaining the company's objectives to the operatives could save time, reduce cost and improve quality. And he added that he saw the supervisor's role as largely one of translating the management team's strategies into meaningful objectives that the "shop floor workers could buy into".

While these comments explained the discrepancies between the prioritisations of manufacturing missions A and G, they did not account for the mismatch with regard to mission F (loss prevention). This was further complicated by the fact that supervisor 1 also thought that the systems emphasised it more strongly than he did. When asked about this supervisor 1 pointed out that there was often a conflict between loss prevention and the other activities. Basically the problem was that the company existed to make money through the sale of products and loss prevention did not particularly help it do this.

Figure 6.36: Data gathered during the interview with supervisor 1 - company D

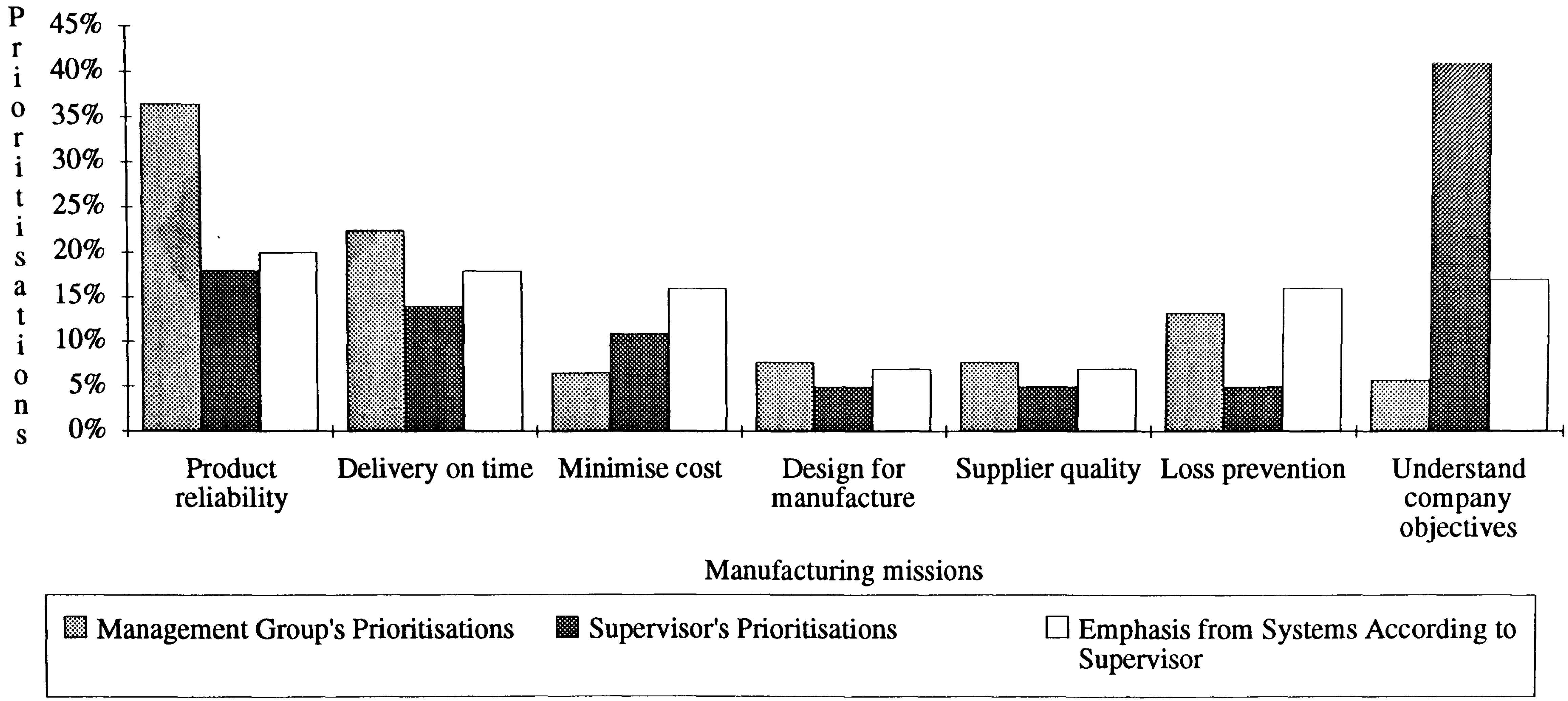


Figure 6.37 - supervisor 2

Figure 6.37 shows that supervisor 2 believed that manufacturing missions B (delivery), C (minimise cost) and G (understand company objectives) were more important than the management group and that missions A (product reliability) and F (loss prevention) were less important. When discussing the discrepancies between missions A and B supervisor 2 explained that on a day to day basis he came under more pressure regarding delivery than quality, and questioned whether the management group's priorities were an expression of what they would like to see, rather than what actually happened. Whilst on this theme supervisor 2 also commented that the reason he had placed less emphasis on manufacturing mission F than the management team was that although they talked about loss prevention, they did very little. Hence he did not think that the firm took it very seriously.

As with supervisor 1, supervisor 2 saw part of his role as translating the management team's strategies into objectives for the shop floor and argued that this was the reason that he thought mission G (understand company objectives) was more important than the management team. Similarly supervisor 2 had run company D's training sessions on waste elimination and suggested that the emphasis he put on mission C (minimise cost) was probably a function of this.

When comparing what the systems emphasised with supervisor 2's prioritisations the biggest discrepancy occurred with regard to manufacturing mission D (design for manufacture). When asked why he thought design for manufacture was so important supervisor 2 simply said; "I see the problems that result when manufacturing is not considered at the design stage".

Figure 6.38 - production controller

Figure 6.38 shows that the main differences in the prioritisations of the management group and the production controller were with regard to missions A (product reliability) and E (supplier quality). When asked if he could explain these differences the production controller said that for him mission E was just

Figure 6.37: Data gathered during the interview with supervisor 2 - company D

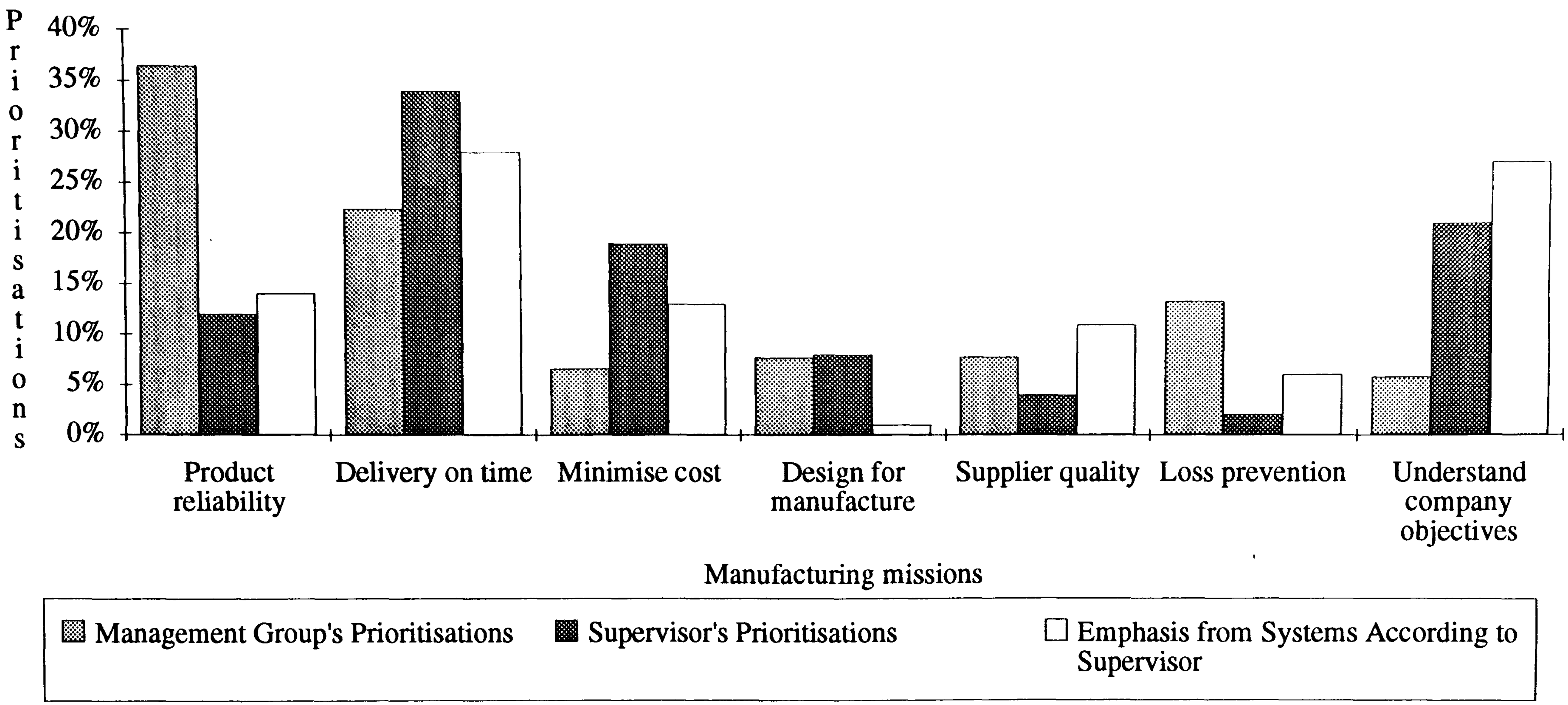
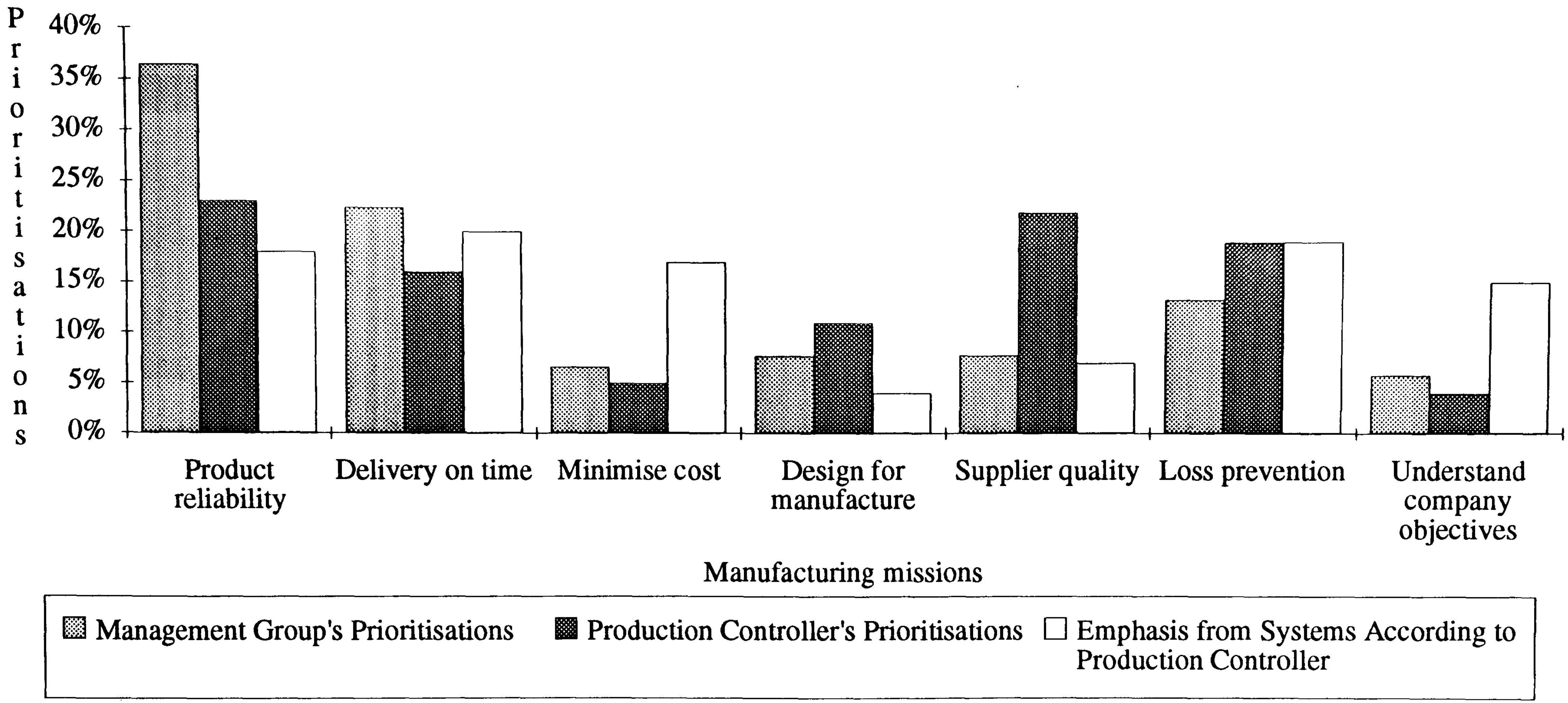


Figure 6.38: Data gathered during the interview with the production controller - company D



as important as mission A, because unless he could arrange for high quality goods to be supplied to they company the rest of manufacturing could not be expected to provide a reliable product.

Comparing the production controller's priorities with what he believed the systems emphasised showed that the production controller had assigned more importance than would be expected to mission E (supplier quality) and less to missions C (minimise cost) and G (understand company objectives). As already discussed the production controller explained that he thought the first mismatch was probably due to his functional role. When asked about the others he said; "we do not have much waste, and therefore scope for reducing costs in my department" and "information on the company's objectives is nice, but I don't think I need it to do my job".

Figure 6.39 - material's controller

Figure 6.39 shows how the material's controller prioritised the manufacturing missions and what he believed the firm's systems emphasised. As with the production controller, the material's controller suggested that most of the differences that could be observed between his priorities and those of the management group were a function of his organisational role. He argued that his job revolved around ensuring that company D received high quality products from its suppliers (mission E) and said that if he got this right then things like product reliability (mission A) would follow. With regard to the systems the major discrepancy concerned mission F (loss prevention). The material's controller offered no explanation as to why this might be.

Figure 6.40 - operative 1

Figure 6.40 shows that the operative 1 believed that manufacturing missions A (product reliability) and B (delivery on time) were less important than the management group, while manufacturing missions E (supplier quality) and G (understand company objectives) were more important. When asked to explain these differences, operative 1 said that she believed if people knew more clearly

Figure 6.39: Data gathered during the interview with material's controller - company D

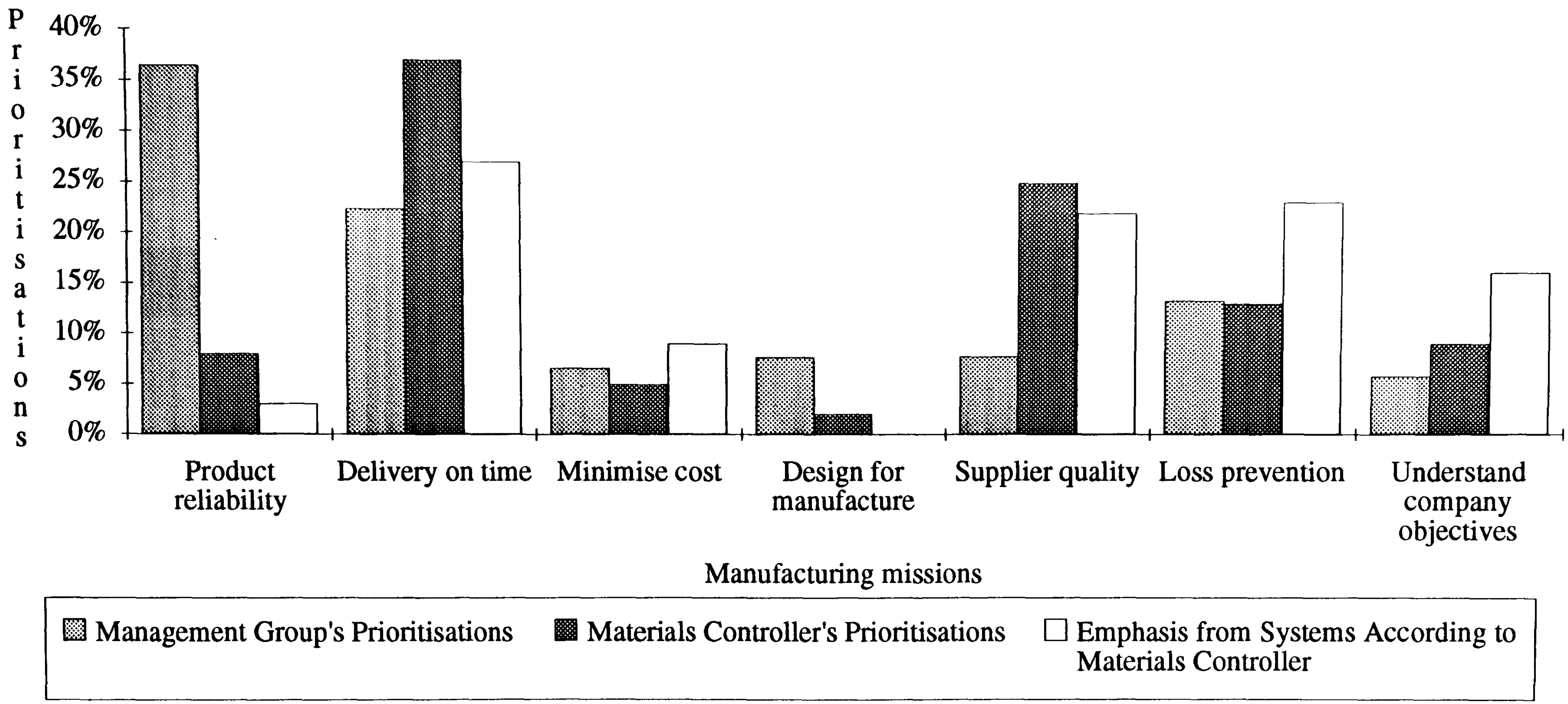
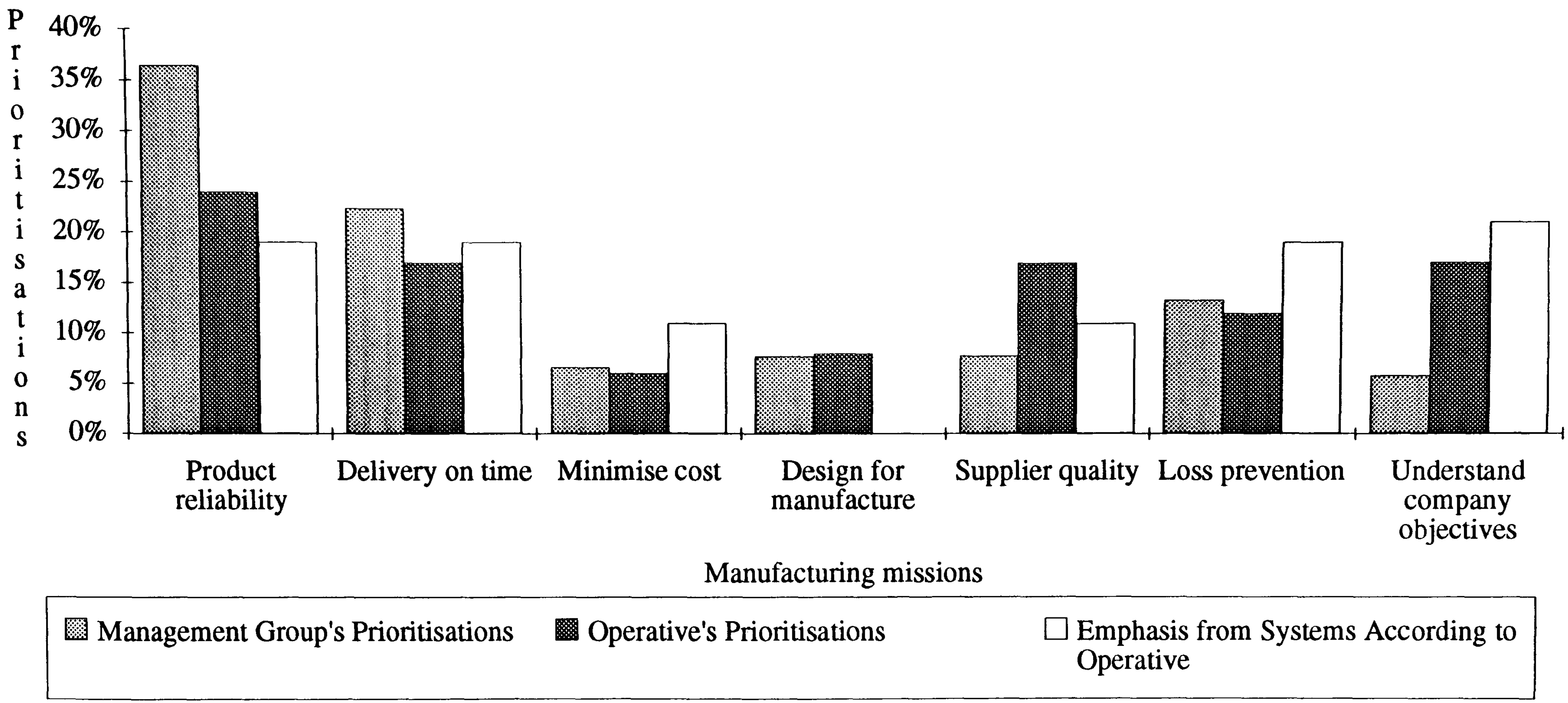


Figure 6.40: Data gathered during the interview with operative 1 - company D



what they were doing then the other missions, including A and B, would be achieved. She also pointed out that supplier quality was important to her personally as it affected how well she could do her job.

When comparing what operative 1 thought the systems emphasised with how she had prioritised the missions, the main differences were that she had perhaps over prioritised supplier quality and design for manufacturing, and under prioritised loss prevention. The reason for the first of these discrepancies has already been explored and as company D was in the process of implementing design for manufacture it was not surprising that the existing systems placed little emphasis on it. As far as loss prevention was concerned, however, operative 1 said; "losses exist and the managers don't do anything about them so they can't be important".

Figure 6.41 - operative 2

As figure 6.41 shows operatives 2's prioritisations were very similar to those of the management group, although there was some minor discrepancy with regard to manufacturing missions D (design for manufacture), E (supplier quality) and F (loss prevention). When asked if she could think of any reasons why these differences of opinion might exist, operative 2 said that both design for manufacture and supplier quality not only had a direct affect on her ability to do her job, but that they also reduced the need for loss prevention.

Operative 2 was not able to explain the differences between her prioritisations and what she believed the systems emphasised.

Figure 6.42 - operative 3

Figure 6.42 shows that operative 3 believed that manufacturing mission E (supplier quality) was more important than the management group, while manufacturing mission F (loss prevention) was less important. When asked if she could think of any reasons why this might have been the case operative 3 said that she thought it was less important to get loss prevention right than

Figure 6.41: Data gathered during the interview with operative 2 - company D

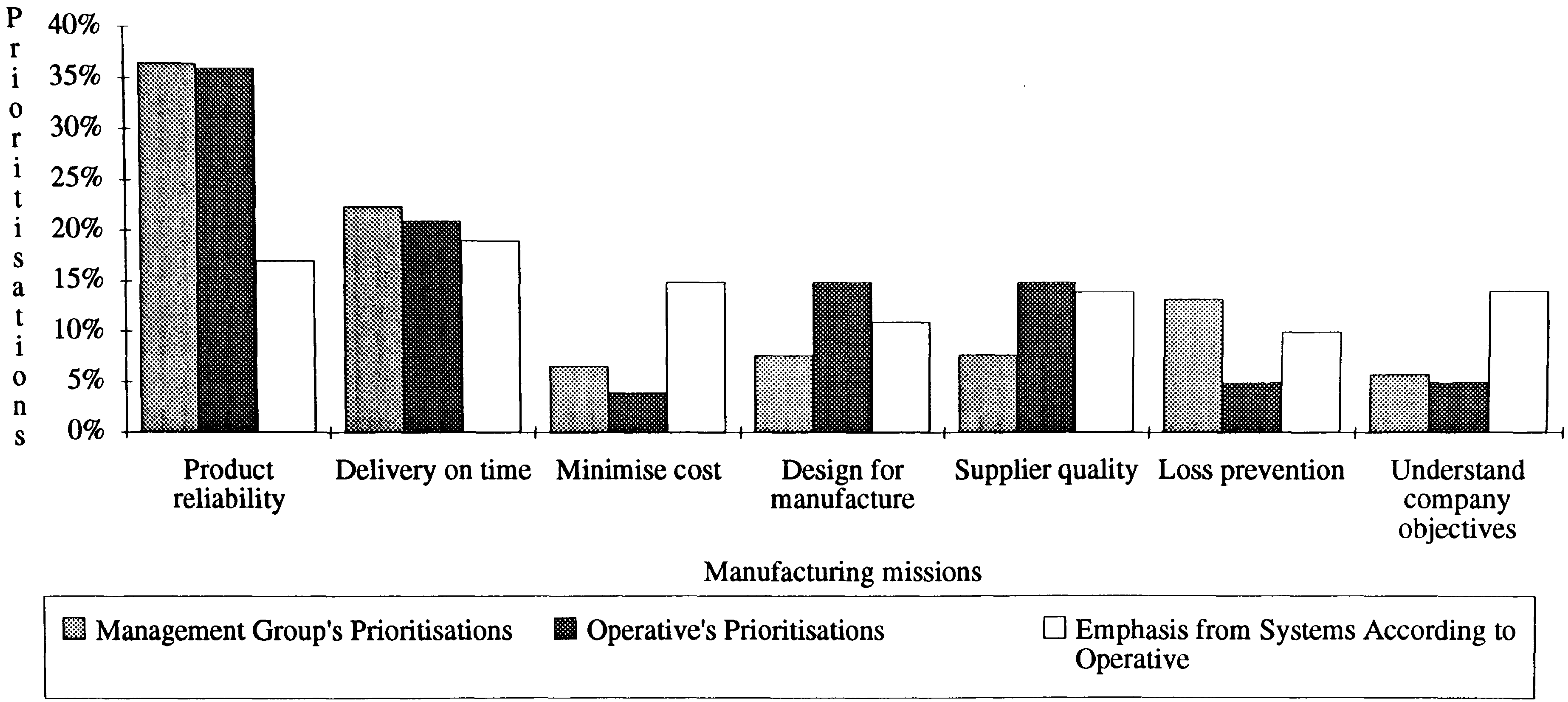
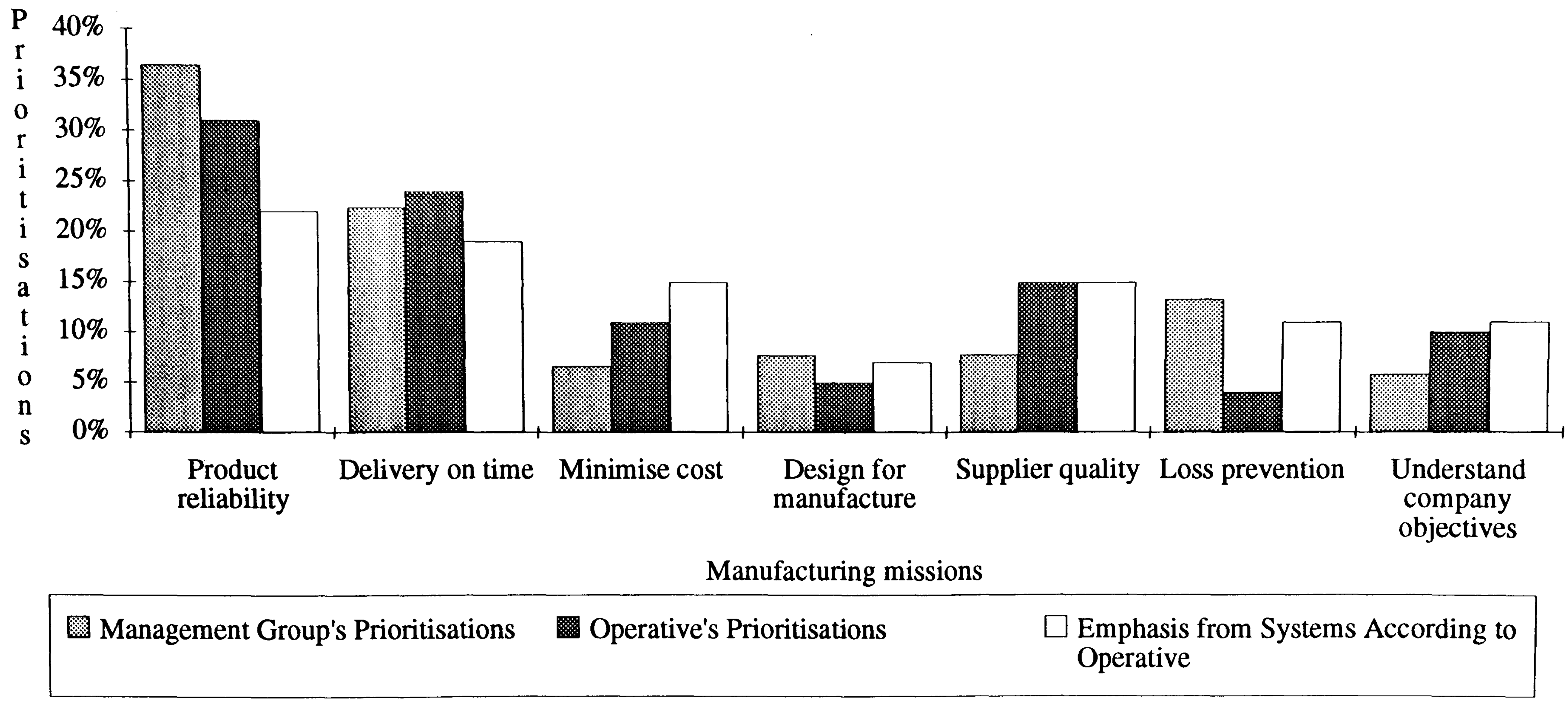


Figure 6.42: Data gathered during the interview with operative 3 - company D



everything else, and pointed out that if company D did not get good quality parts from its suppliers it could not achieve manufacturing missions A, B or C.

Comparing what operative 3 believed the firm's systems emphasised with her prioritisations suggests that she had attributed more importance to product reliability than would be expected and less to loss prevention. The reason for the second of these mismatches has already been explored. When asked about the first operative 3 simply said; "quality is what gives the customer his first impression. Hence it must be important".

Figure 6.43 - operative 4

Figure 6.43 shows that operative 4 prioritised manufacturing missions E (supplier quality) and G (understand company objectives) more highly than the management group, and manufacturing mission A (product reliability) less highly. When asked if he could explain these differences operative 4 said that he had not realised the management group thought product reliability was so important, especially as they had just disbanded the Quality Assurance (QA) department and were now expecting staff on the line, who were less well qualified, to look after their own quality. With regard to mission G, operative 4 pointed out that company D had undergone a massive amount of change in the last ten years and he was not sure that many people understood why. Hence he thought it was important that the management group made more effort to explain the company's objectives.

Operative 4 not only attributed more importance to mission E than the management group, but also more than would be expected considering how much he thought the systems emphasised the importance of supplier quality. When asked to explain this, operative 4 said that before he could build high quality boards he had to have high quality parts.

Figure 6.44 - operative 5

Figure 6.44 shows that operative 5's prioritisations differed widely from both

Figure 6.43: Data gathered during the interview with operative 4 - company D

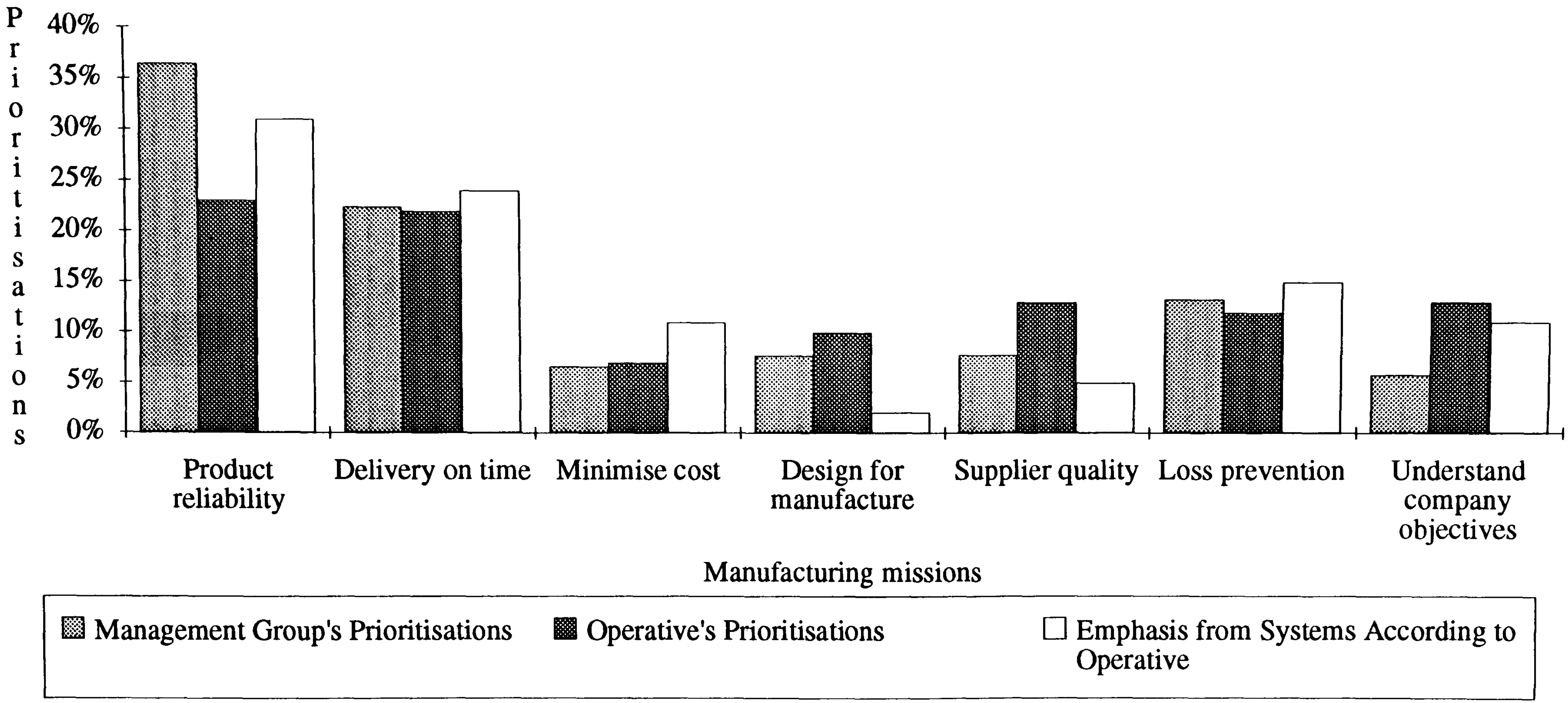
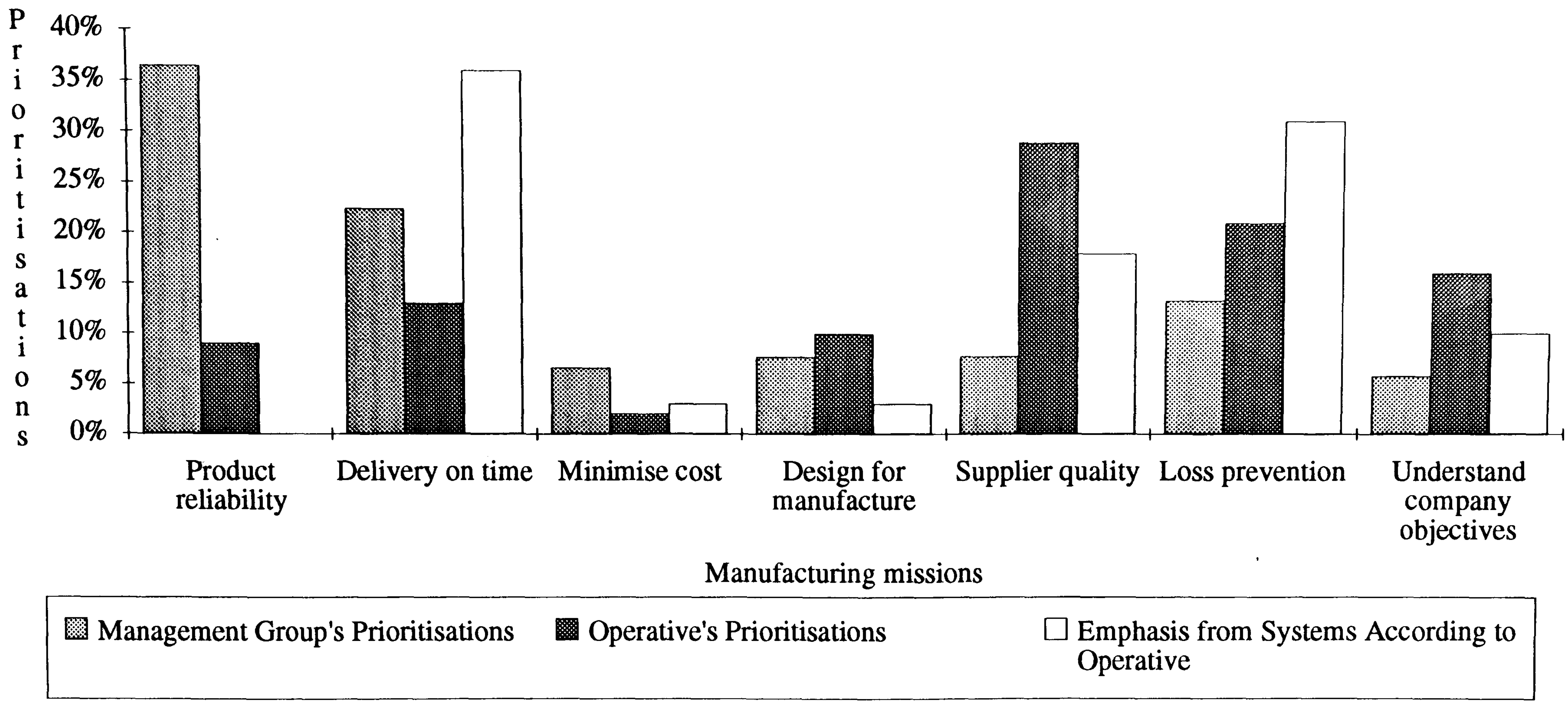


Figure 6.44: Data gathered during the interview with operative 5 - company D



the management group and what might be expected, given what he thought the systems emphasised, with regard to missions A (product reliability), B (delivery), E (supplier quality) and F (loss prevention). When asked if he could think of any reasons to explain these discrepancies operative 5 said that manufacturing mission A focussed on external, not internal quality, and that as far as he was concerned the firm's systems only emphasised internal quality. In addition he also pointed out that company D had recently had some problems with its suppliers and this had shown that if high quality components were not being supplied then it was impossible for the operatives to product reliable products. Operative 5 was unable to offer any logical explanations for the remaining discrepancies.

Figure 6.45 - operative 6

Figure 6.45 shows that operative 6's prioritisations differed from those of the management group mainly with regard to manufacturing missions E (supplier quality) and F (loss prevention). When discussing supplier quality operative 6 said that it was important to her because she dealt with a lot of bought out parts and hence could not produce reliable products unless her suppliers gave her high quality parts. As for mission F, operative 6 argued that, despite what the management team said, they did not take loss prevention as seriously as the other manufacturing missions. When discussing the systems operative 6 mentioned that she often received feedback directly from the customer and hence she knew that product reliability important.

Figure 6.46 - operative 7

Figure 6.46 shows that operative 7's prioritisations are broadly similar to those of the management group, although there is some discrepancy with regard to manufacturing mission E (supplier quality). Operative 7 said that this was due to the fact that he was at the sharp end and if there was a problem with supplier quality he was one of the people who suffered most.

With regard to the differences between what operative 7 thought the systems

Figure 6.45: Data gathered during the interview with operative 6 - company D

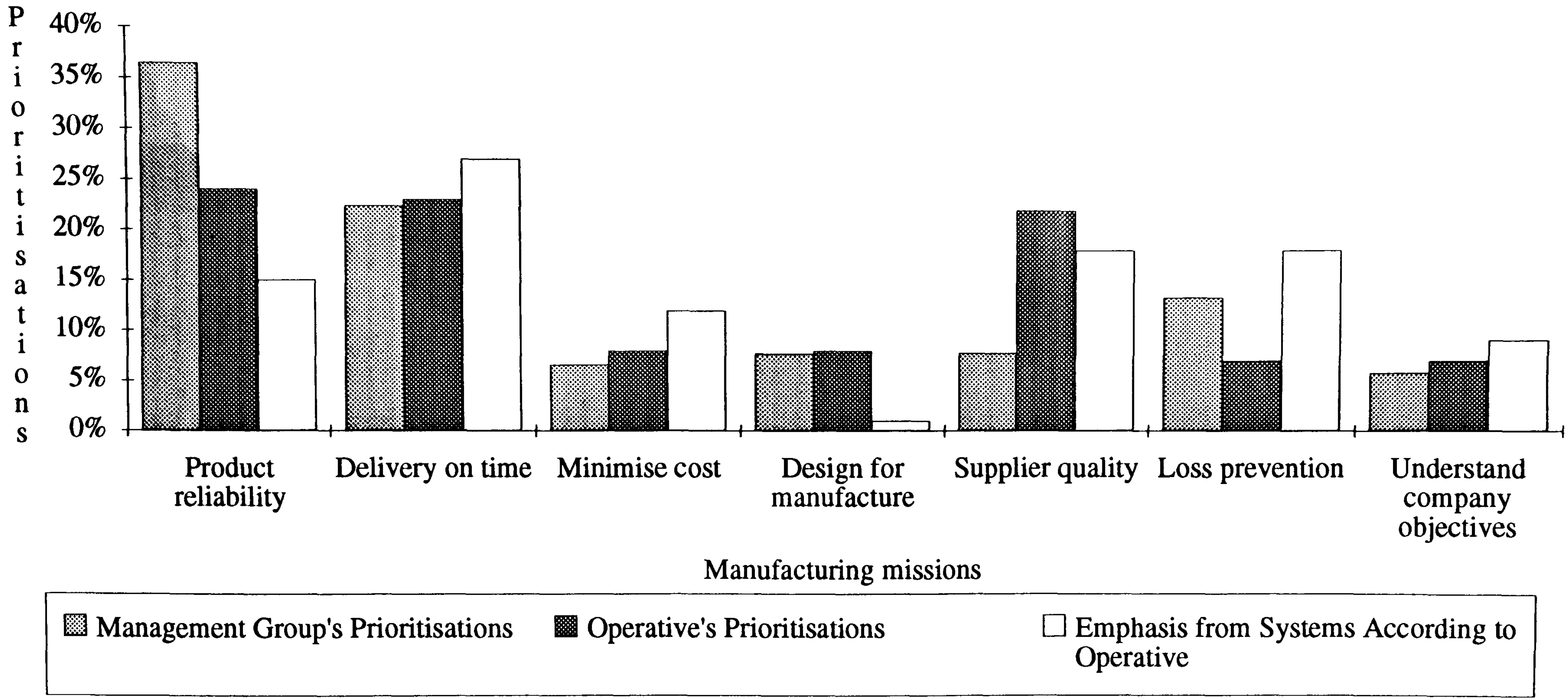
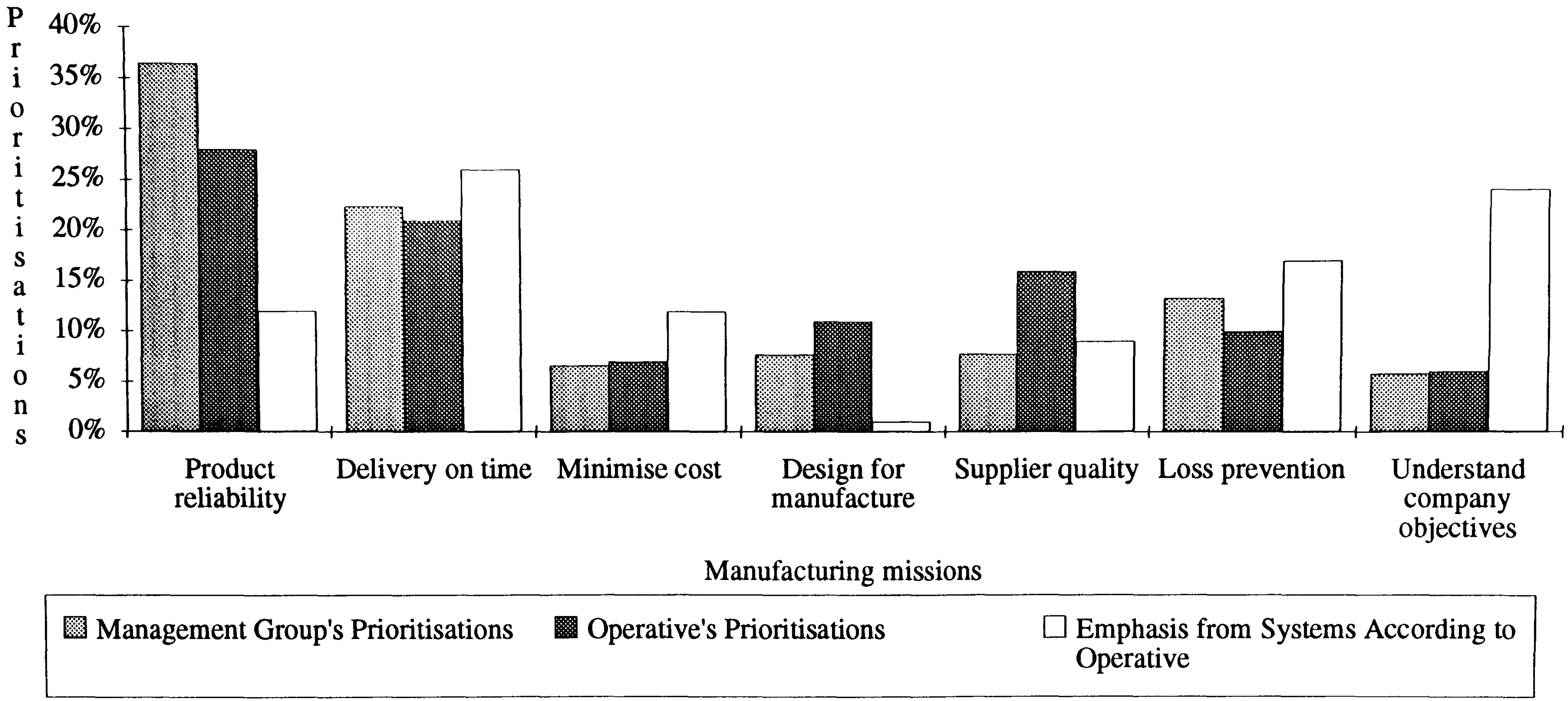


Figure 6.46: Data gathered during the interview with operative 7 - company D



emphasised and his prioritisations the most interesting point that emerged was that he did not feel he had to understand the company's objectives in order to do his job.

Figure 6.47 shows in aggregate the way in which the various groups of interviewees and managers prioritised the manufacturing missions. Once again it can be seen that there is a higher level of goal congruence between the operatives as a group and the managers on most of the missions, and that there is broad agreement with respect to the importance of missions B and D. The "other staff" (the materials and production controller) place slightly more emphasis on mission B than the rest but, as already discussed, this is probably a reflection of their functional role. The supervisors appear to see their task as balancing outgoing product quality (mission A), delivery (mission B) and reduction of non-value added activities (mission C). They also appear to strongly believe that if they are to be successful at this then it is important that they explain the company's objectives to the operatives (mission G).

The operatives see their job as making sure that high quality products (mission A) are delivered on time (mission B). Note how they shift the emphasis slightly from outgoing quality (mission A) to incoming quality (mission E). As has already been seen a number of the operatives interviewed complained that they were let down by poor quality of incoming parts. Hence once again this emphasis may be a function of their role.

Mission F (loss prevention) raises some interesting issues. In the management group's discussion it was the mission about which there was most debate and least agreement. As far as both the supervisors and the shop floor workers were concerned they received a lot of information about loss prevention but many of them said that little was done about it and hence they felt it was one of the less important missions. Furthermore a number of people pointed out that if missions A (product reliability) and B (delivery) were not achieved then there was no point in having mission F (loss prevention).

Figure 6.47: Prioritisation of company D's manufacturing missions

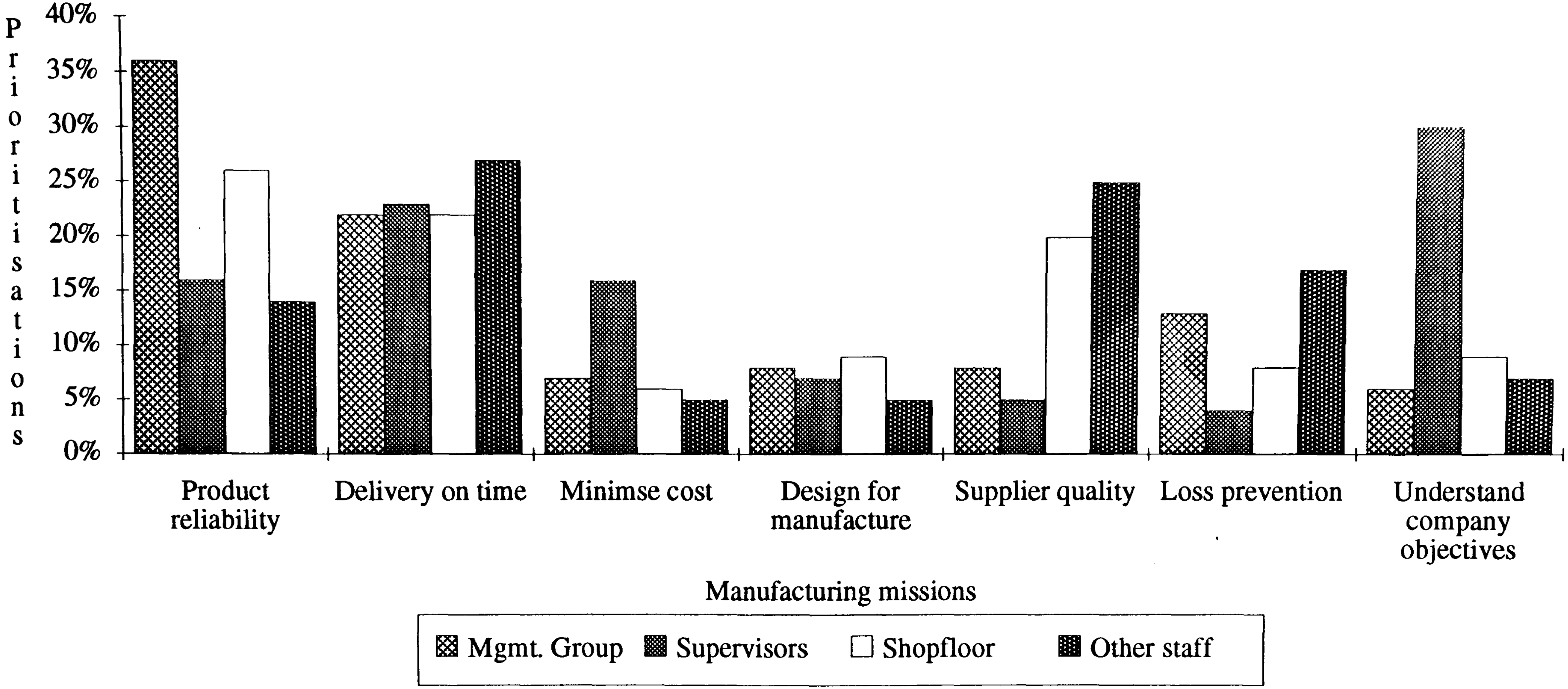


Figure 6.48 and 4.49 show what the operatives and supervisors as separate groups believed the firm's systems emphasised. From figure 6.48 it can be seen that the two supervisors thought that the management by results systems and the group/area meetings had the greatest influence on them, while the manufacturing communications meetings meant little to them. Similarly figure 6.49 shows that the operatives believed that both the management by results system and the group/area meetings had quite a strong influence on them, while the quality attributes measurement system and the monthly quality meetings had little affect on them. Both the supervisors and operatives reported that the fact that visitors were encouraged to talk to them was relatively uninfluential.

In summary, then, it appeared that there were two reasons why company D might have been unable to realise its manufacturing strategy. The first, as shown by figure 6.47, was that the company was not receiving high quality components from its suppliers. The fact that so many of the operatives prioritised manufacturing mission E (supplier quality) so highly indicated that this was currently of concern to them. The fact that the management group did not prioritise supplier quality so highly suggested that perhaps they were unaware of the severity of the problem. Having said this, however, the fact that both the production and material's controllers rated manufacturing mission E so highly indicates that company D was taking steps to solve this problem.

The second reason that company D might have been unable to realise its manufacturing strategy was that loss prevention (mission F) was not being taken seriously. Figure 6.47 shows that the management group rated this mission more highly than the supervisors and operatives. And as discovered in the interviews the principle reason for this was that although the management team talked about loss prevention they put little effort into making it happen. An obvious parallel can be drawn with company C here, for in both cases the managers were failing to support there words with actions.

In chapter 3 it was pointed out that sometimes goal incongruence can be the

Figure 6.48: What the supervisors of company D believe the systems emphasise

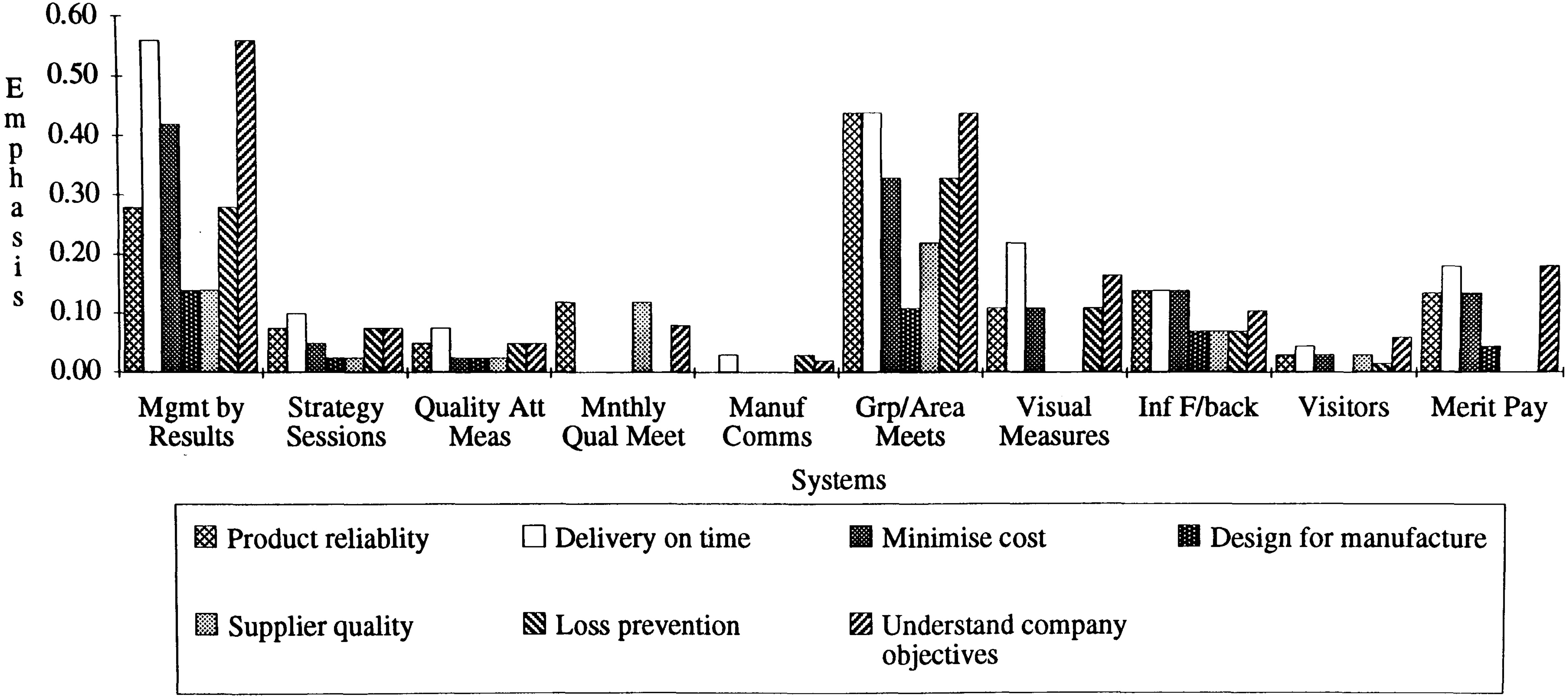
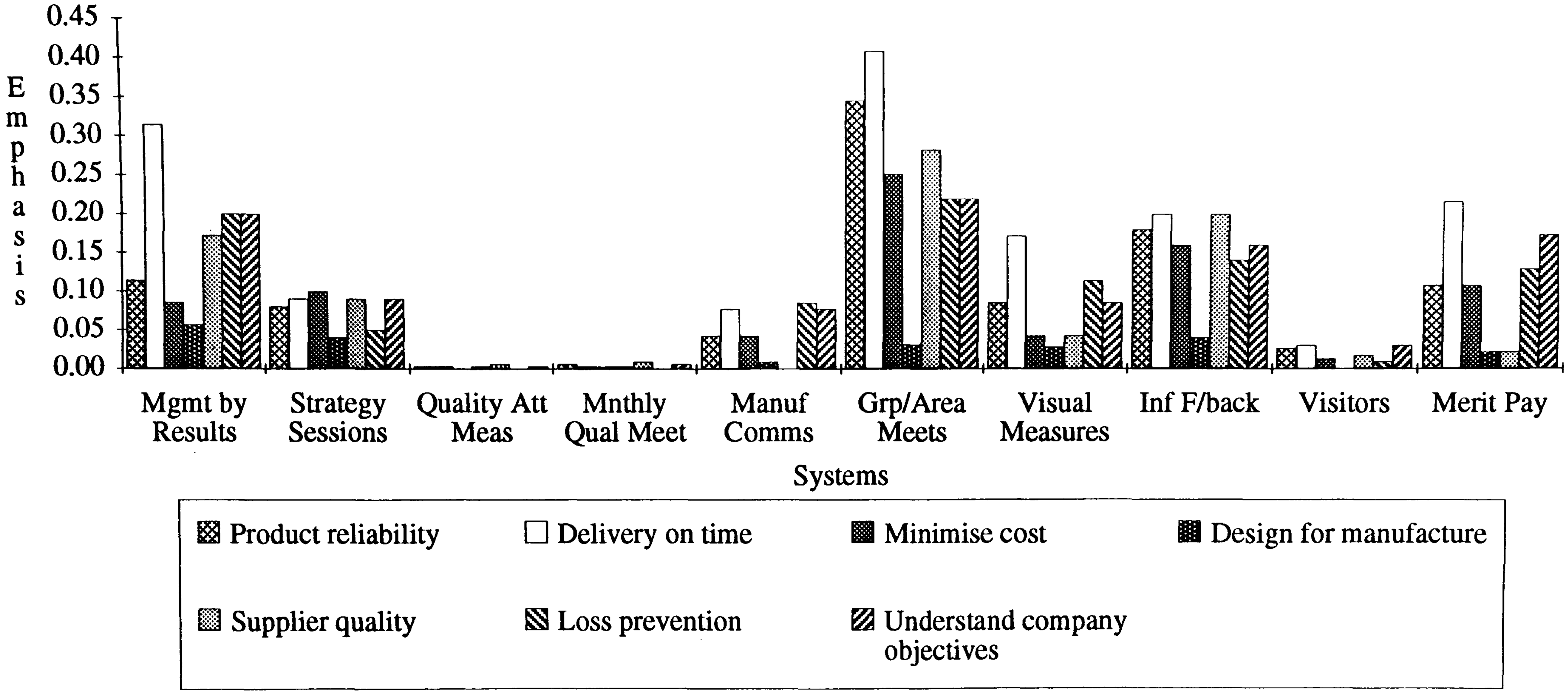


Figure 6.49: What the operatives of company D as a group believe the systems emphasise



result of someone's functional role and not necessarily a case for concern. Company D provides two excellent examples of this. The first - supplier quality - has already been discussed. The second relates to mission G (understand the company objectives). At first sight the fact that the supervisors prioritised mission G so highly in comparison to everyone else might be seen as a problem. When feeding back the data gathered during the study to company D, however, this goal incongruence was discussed. And as a result it became apparent that the two supervisors had correctly interpreted their role in the organisation. That is, the management team agreed that one of the primary tasks of the supervisors was to translate the firm's manufacturing strategy into a set of meaningful objectives that the "shop floor workers could buy into".

6.4: Summary

This chapter has described the third and final phase of this research - the integration of the goal and system congruence audits and the application of the resultant congruence audit. In both case studies the congruence audit was able to identify some of the reasons why the firms concerned might have been unable to realise their manufacturing strategies. In company C the data that were gathered suggested that the managing director's actions were encouraging the production manager, among others, to pursue a strategy based on delivery performance rather than one based on product quality as was intended. Evidence to support the accuracy of this observation was provided both by the quality coordinator's independent study which found that outgoing product quality was very poor, and subsequent discussions with the managing director. Indeed shortly after the study was completed the managing director asked the author to feed back the results of the study to everyone involved and, at that meeting, publicly declared that he wanted the firm to pursue a manufacturing strategy based on product quality in the future.

In the case of company D the congruence audit identified two areas where the firm was unlikely to be able to realise its manufacturing strategy. The first was with regard to the supply of high quality components. The second was with respect to loss prevention. Upon completion of the study these observations were fed back to company D. Since then the author has spoken to the personnel manager and he has confirmed that the management team now acknowledges the importance of both of these issues. This having been said, however, company D is currently being merged with another organisation and hence although the management team are actively reviewing the performance of their suppliers, they have been unable to resolve the issue of whether loss prevention really is important for them to date.

CHAPTER 7: DISCUSSION

CHAPTER 7: DISCUSSION

7.0: Introduction

In chapter 3 it was stated that the key assumptions underlying the research reported in this thesis are that consistency of decision making and action, and hence realisation of strategies, might best be achieved if:

(a) **The manufacturing task, defined in terms of quality, delivery speed, delivery reliability, price (cost) and flexibility, is widely understood by those employees who affect whether the task is achieved.**

(b) **The firm's goal setting, performance measurement, feedback and reward systems are used to induce decision making and action consistent with the manufacturing task.**

This chapter critically appraises these assumptions as the framework shown in figure 3.1 and the congruence audit which they underpin are reviewed.

The remainder of the chapter has been divided into three sections. In the first the strengths and weaknesses of the congruence audit are discussed. In the second the conceptual framework on which the research was based is reviewed and a modified version of it is presented. In the third the chapter is summarised.

7.1: Critique of the congruence audit

As described in chapter 6 the congruence audit developed during the course of this research consisted of three main phases:

-management group discussion;

-individual interviews;

-data analysis and feedback.

Data were collected on the strengths and weaknesses of each of these phases by the author through his participant observation. These data are summarised in table 7.1 and discussed in detail in the reminder of this section.

7.1.1: **Management group discussion**

The management group discussion involved three main stages; the definition of the manufacturing task, the prioritisation of the manufacturing missions, and the identification of the firm's systems. One of the strengths of the management group discussion is that it acts as a team building exercise and forces the people involved to air and debate, if not resolve, any differences of opinion they might have with regard to the manufacturing task. In addition the data produced during the group discussion provide a structure for the subsequent interviews and data analyses, which simplifies the congruence audit as a whole.

In terms of weaknesses the discussion was time consuming and required the participation of most of a firm's senior managers for between three and four hours. The time taken by the discussion was lengthened by the presence of the external facilitator, for two reasons. First because the management group had to explain more to the facilitator. Second because the facilitator had to tread warily as he did not have any prior knowledge or understanding of either the group dynamics or the organisational politics.

Perhaps the greatest weakness with the discussion, however, was the fact that it was based on the assumption that the firms being audited would have, or would wish to develop, manufacturing strategies which matched the traditional academic model. Initially it was assumed that each management group would define their firm's manufacturing task solely in terms of quality, time, price (cost) and flexibility[25]. In both companies C and D, however, the managers present at the group discussions wanted to include other factors such as; education and training (company C), elimination of non value added processes

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25 The category other was included in the framework shown in figure 6.2 so that the importance of factors such as concern for the environment could be included without having to force them under one of the traditional categories.

Table 7.1: Strengths and weaknesses of the congruence audit

	Strengths	Weaknesses
Group Discussion	-A team building exercise which ensures that the management group develops a shared view of the manufacturing missions. -Highlights differences of opinion and forces them to be debated. -Gives the facilitator an opportunity to learn the company language. -Provides a structure for the rest of the process thereby simplifying the data analysis.	-Confusion over strategy, the issue of what versus how. -The facilitator does not know, or understand, the group dynamics or politics at the outset. -Potentially a time consuming process which involves the senior management team for three to four hours.
Individual Interviews	-Rapid (one hour), self contained interview. -Visual feedback used to stimulate discussion and to check the validity and reliability of the data that have been collected. -Combination of simple data collection techniques, the majority of which focus on quantitative data. -External facilitator who offers confidentiality.	-An unknown interviewer needs to gain the interviewee's trust at the start of the interview. -Although the data that are collected are quantitative they are based on the interviewee's opinions and not on facts. -The questionnaire scale can encourage invalid responses. -System congruence is an abstract concept and difficult to explain.
Data Analysis and Feedback	-Multiple inputs to the data collection process (discussion and interviews) enable the facilitator to paint a rich picture. -All employees who participate in the study can be invited to a feedback session, which provides an opportunity to build a wider team. -The feedback session gives the management group with an opportunity to reinforce the importance of specific missions.	-Data analysis is based on averages. Hence detail is lost and some of the more extreme opinions can be missed. -The facilitator's interpretation of the data, particularly that gathered during the discussions at the end of the individual interviews, might be incorrect.
Overall	-Provides insight by offering a novel means of exploring why a firm might be unable to realise a strategy. -Identifies how widely the manufacturing missions are understood. -Determines which systems reinforce which manufacturing missions. -Can be completed rapidly. (Total elapsed time for company D, including data analysis and feedback, was five working days).	-The data are based on opinions and recollections, not observations. -The process requires a skilled external facilitator. -It can raise individual's expectations (i.e. the feedback session), but does not produce a specific action plan.

and materials, and design for manufacture (company D). As mentioned in the previous chapter these missions caused considerable debate, with the author being keen to emphasise that they were solutions or ways of achieving specific parts of the manufacturing task, i.e. policy decisions, rather than elements of the task itself. The managers, however, did not wish to make this distinction. They argued that if they had decided that an essential part of manufacturing's role was, for example, the elimination of non-value added processes and materials (company D), then this became part of the task rather than a means of achieving it.

In terms of the application of the congruence audit the confusion over the manufacturing task and policy decisions could have caused problems in the second stage of the management group discussion - the prioritisation of the manufacturing missions. Take, for example, company D. Manufacturing mission B (delivery on time) can be seen as a short term activity, whereas manufacturing mission F (loss prevention) can be seen as a long term activity. This difference in time scale makes the comparison and prioritisation of the missions difficult. Having said this, however, the question used to gather the data during the pairwise comparison process, namely "which is more important **to the long run success of the firm** - manufacturing mission B or manufacturing mission F", provides some context, thereby reducing the problem.

The confusion over the manufacturing task and the policy decisions also has implications for manufacturing strategy research in general, for it leads one to question the validity of the traditional academic model of manufacturing strategy. Quinn (1980) has suggested that strategies are developed and realised through a process of logical incrementalism. That is, managers have a vision of where they want their firm to be, and take small evolutionary steps until they realise their vision. This description accurately reflects the management processes used in companies C and D. When prompted, either during a structured interview or as part of the group discussion, each manager could state what the manufacturing function ought to do, but they could not, in general, explain how it should do it. It was as if each manager had an implicit definition of the manufacturing task in terms of quality, time, cost and flexibility. To this they added the policy decisions that had already been made, but they left all other policy decisions open.

On reflection this appears to be a logical way of managing. During the process of trying to realise their manufacturing strategies the managers will learn what works and what does not work. Hence, at one level, to suggest that all the policy decisions should be made during the strategy formulation process is naive, because this assumes that it is possible for a group of people to predict all eventualities, and, perhaps more importantly, it ignores the fact that they will learn during the strategy realisation process. On the other hand, however, there is a danger that if the managers are not pushed to consider all the options open to them during the strategy formulation process they may end up pursuing a course of action (a policy decision) which is less than optimal.

In terms of research on manufacturing strategy, then, there appears to be a need to explore the strategy development and implementation processes more fully. This will involve examining issues such as:

-How are the manufacturing strategy policy decisions made in firms?

-Should all policy decisions be made at the same point in time and then revisited after a fixed period?

-How can one ensure that a management group explores all the various strategic options that are open to them at a point in time?

In terms of the research reported in this thesis the fact that the firms involved in the study did not have manufacturing strategies which matched the traditional academic model leads one to question how it was possible to test the second of the propositions listed in chapter 3, namely that the congruence audit can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy. However, just because the firms involved in the research did not have manufacturing strategies which corresponded to an academic model does not mean that they did not have manufacturing strategies at all. As far as the managers were concerned their manufacturing strategies were summarised by the manufacturing missions which had been formally defined during the group discussion. Their plan for achieving these strategies was incrementally to test out various strategic options until they identified those that were most appropriate. As was shown in chapter 6 the congruence audit identified areas of incongruence which might have inhibited the realisation of these manufacturing strategies, either because certain groups of employees did not know what they were meant to be doing, or because the firm's systems sent them signals which encouraged them to pursue courses of action which were inconsistent with the manufacturing missions and hence manufacturing's task.

7.1.2: **Individual interviews**

The individual interviews consisted of three main stages; the prioritisation of the pre-defined manufacturing missions, the identification of what the firm's systems encouraged people to do, and a structured discussion. In terms of strengths these interviews were rapid - they could be completed in under one hour - and they were conducted by an external facilitator who offered confidentiality and therefore the opportunity for the interviewees to express views and opinions that otherwise might not have been aired.

Perhaps the greatest strength of the individual interviews, however, was the use of computer generated graphics to stimulate discussion. At the outset the interviews were designed so that simple data collection techniques could be used to gather data which were predominately quantitative. This was done so that the data could be analysed immediately and fed back to the interviewee during the course of the interview. This not only gave the interviewer an opportunity to check that the data he was collecting were both valid and reliable, but also allowed him to probe, in a non-threatening way, any apparent discrepancies between the interviewee's perceptions and those of the management group. As chapter 6 showed this procedure considerably enriched the data collection process and enabled the interviewer to ask very focussed questions during the discussion. As an aside, it should be noted that a number of the interviewees commented that the provision of immediate feedback made the interview more personally satisfying as it helped them understand the study more fully.

At a more detailed level the majority of people interviewed found it easier to relate to the graph which showed how their opinions compared to those of the management group (see figure 6.10), than they did to the one which showed how their opinions related to what the firm's systems emphasised (see figure 6.11). In itself this is not an unexpected observation as the latter graph is based on a more complex set of relationships and analyses. It did, however, have implications for the discussion as it meant that any questions regarding the relationship between the manufacturing missions and the firm's systems had to be phrased in terms of practical examples rather than abstract concepts.

In terms of weaknesses the second stage of the interview sometimes caused problems. In this each interviewee was asked to say what the firm's systems encouraged them to do and how much they influenced their actions. A questionnaire of the format described section 6.1.2. was used to collect the first set of data, but as discussed earlier the problem with it was that the format of the question and the scale used (strongly agree through to strongly disagree) led to some of the interviewees giving invalid responses. That is, sometimes they ticked the box labelled "disagree", when they should have ticked the box labelled "no relationship".

To overcome this problem the author double checked with each interviewee whether they really meant disagree when their first response suggested that they did. Not only did this ensure that the data that were collected were valid, but it also provided extra information when an interviewee disagreed with one of the statements in the questionnaire. Take, for example, the routing card system operated by company C. This goal setting system was supposed to provide the foremen with target delivery dates for each batch of work. However one of the foremen disagreed with the statement "the routing card system emphasises the importance of delivering products on time" and when asked why, he said; "because even when the routing cards have delivery dates on them they are wrong. This suggests that the firm does not really care about delivery on time".

7.1.3 Data analysis and feedback

The final phase of the congruence audit involved data analysis and feedback. In both of the case studies described in chapter 6 the author was invited to present the findings of his investigation to everyone who had participated in the study. This feedback phase was important because:

-It ensured that the company benefited from the research.

-It provided the management team with an opportunity to reinforce publicly their commitment to specific manufacturing missions.

-It enabled the author to qualitatively assess the accuracy of the data analyses described in chapter 6.

In terms of strengths, the structure of the audit provided a lot of data from different sources and hence enabled the facilitator to paint a rich picture of what appeared to be happening in a firm. On the other hand, the fact that the data were subjective and based on people's opinions and recollections, rather than on direct observation of their behaviour, meant that the validity of any data which were not confirmed by multiple sources could be questioned. As far as the feedback to the companies was concerned the data that were presented were disguised because individual confidentiality had been assured during the interviews and hence, out of necessity, some detail was lost. In addition the analyses were based on the author's interpretations of the data, particularly those gathered during the discussion stage of the individual interviews, and hence could have been subject to his bias. Despite these reservations, however, the analyses presented in chapter 6 were confirmed as accurate reflections of what was happening in companies C and D, both by the individuals present at the feedback sessions and by the subsequent actions of the managers.

In the next section the strengths and weaknesses of the congruence audit as a whole will be summarised. These observations will then be coupled with what the author learnt during the research to provide a basis for a critique of the conceptual framework which underpins the research.

7.1.4: Strengths and weaknesses of the congruence audit

The greatest weakness of the congruence audit, as it has been described, was that all the data that were collected during it were based on people's perceptions rather than actual observations of their behaviour. LaPiere (1934) was perhaps the first to report how important this distinction is. Between 1930 and 1932 he toured the U.S. with a young Chinese student and his wife. During that time they stayed at 66 different hotels, or auto camps, and ate at 184 different restaurants. Despite the supposed US racism they were turned away only once in 250 instances. Six months after the tour had finished LaPiere surveyed all the establishments they had visited asking; "will you accept members of the Chinese race as guests in your establishment". Of the 120 responses he received, 81 (92%) restaurants and cafes, and 47 (91%) hotels and auto camps, said no. Of the remainder, all but one said it would depend on the circumstances. From this LaPiere (1934) concluded that the models that humans use to predict how they will behave when faced with an abstract situation are not necessarily accurate.

The data gathered during the congruence audits were based on such abstract situations. In the group discussion the managers were asked to say which of the manufacturing missions they believed were the most important. In the individual interviews the interviewees were not only asked the same question, but also whether they thought the firm's systems reinforced the importance of the manufacturing missions. Hence it could be argued that the data gathered during the course of the audit were of dubious validity.

The fact that the audit involved multiple interviews all of which focussed on the same issue, however, negates this criticism because as the cases described in chapter 6 showed, the data that were collected actually highlighted the difference between what the managers think they do and what they actually do. The reason that the audit is able to highlight such discrepancies is because it involves the collection of data from multiple sources which can be cross referenced.

The greatest strength of the congruence audit, however, becomes apparent when it is viewed as a process or a means of analysis. For then it can be seen that the congruence audit provides a novel means of:

-Defining what a management group believes manufacturing should be doing.

-Identifying what other employees think manufacturing actually is doing.

-Establishing whether any mismatches in perception occur.

-Determining whether such mismatches in perception are a function of the organisation's goal setting, performance measurement, feedback or reward systems.

-Provoking debate so that the issues raised can be resolved.

7.2: **Conceptual underpinnings**

The conceptual framework shown in figure 3.1 underpinned the pilot versions of the goal and systems congruence audits. During the course of this research, however, three improvements that could be made directly to figure 3.1 were identified. One other particularly relevant issue also arose. The purpose of this section is to discuss these.

The first improvement that could be made to figure 3.1 emerged during the development and testing of the goal congruence audit as it became apparent that the generic terms quality, time, cost (price) and flexibility were inadequate if one wanted to precisely define the manufacturing task. Hence in the pilot studies the generic terms quality, time, cost (price) and flexibility were broken down into their constituent elements (see figure 4.1). The data gathered in companies A and B indicated that the lack of goal congruence was largely due to the prioritisation of the factors which together constituted the manufacturing task rather than their definition. Furthermore these data suggested that even the list of factors in figure 4.1 was incomplete (see figure 4.23). Hence it was decided that in the full congruence audit a management group would be asked to identify and define the manufacturing missions at the outset of the congruence audit using the framework shown in figure 6.2. As shown in figure 7.1 this framework has therefore replaced the contents of the top box of the original version of figure 3.1.

The second improvement that could be made to the model emerged during the development and testing of the system congruence audit, although further evidence to support it was found during the subsequent congruence audits. As discussed in chapters 3 and 5 the concept of system congruence is based on the organisational behaviour literature which talks about management control and performance management, and the business strategy literature which discusses strategic control. Implicit in both of these literatures is that consistency of decision making and action can be induced through appropriately designed goal setting, performance measurement, feedback and reward systems. Hence at the outset of this research it was believed that the goal setting, performance measurement, feedback and reward systems used in the manufacturing function should be directly related to the manufacturing task. Discussions and interviews with managers in a number of U.K. firms, however, suggested that explicitly linking reward systems to the manufacturing task can hinder a firm's ability to introduce new working practices, as those who have to implement or accept the changes may have a vested interest in maintaining the status quo. Further interviews and discussions, with managers in both Japan and the U.K., provided a number of examples of firms which had no explicit link between their reward systems and the manufacturing task, but were still apparently managing to realise their strategies.

Interestingly the issue of whether a firm should use its reward systems to reinforce the importance of the manufacturing task appears to be related to the organisation's culture. Table 7.2 shows those systems that the operatives of companies C and D believed had the greatest influence on their actions. Note how in company C all the most influential systems were reward based, while in company D two of the three most influential systems relied on feedback. This suggests that companies C and D employ reward and feedback respectively to encourage their employees to pursue courses of action congruent with their manufacturing task. In addition the logic that the interviewees in company C used when deciding which systems influenced them the most was interesting. When asked for example; "which influences your actions more - your basic salary or the spot bonus" most of the operatives in company C replied; "my basic salary is worth more to me than the spot bonus, hence it must influence me more". And as a result the perceived influence of each of the systems used in company C correlates with its financial worth. This suggests that the way to encourage the operatives of company C to do something is to offer them a financial incentive. In company D, however, financial incentives were not seen as so important. And given the earlier discussion regarding the problems with reward systems (see chapter five), a key question for the managers of company C is how can the process of changing the organisation's culture from one based on reward to one based on feedback best be managed?

Table 7.2: The systems reported as influencing the operatives the most

Company C		Company D	
Basic salary	30%	Group/area meetings	22%
Plus rate	16%	Management by results	20%
Spot bonus	13%	Merit pay	15%

In terms of the framework underpinning this research the above observations relate to the bottom box shown in figure 3.1 and the second of the assumptions stated at the beginning of this chapter, namely that all of the firm's systems should be used to reinforce the importance of the manufacturing missions. As figure 7.1 shows, this research has raised, but not sought to answer, the question of whether this is indeed the case, or whether the firm's reward systems should remain neutral, i.e. unrelated to any of the manufacturing missions.

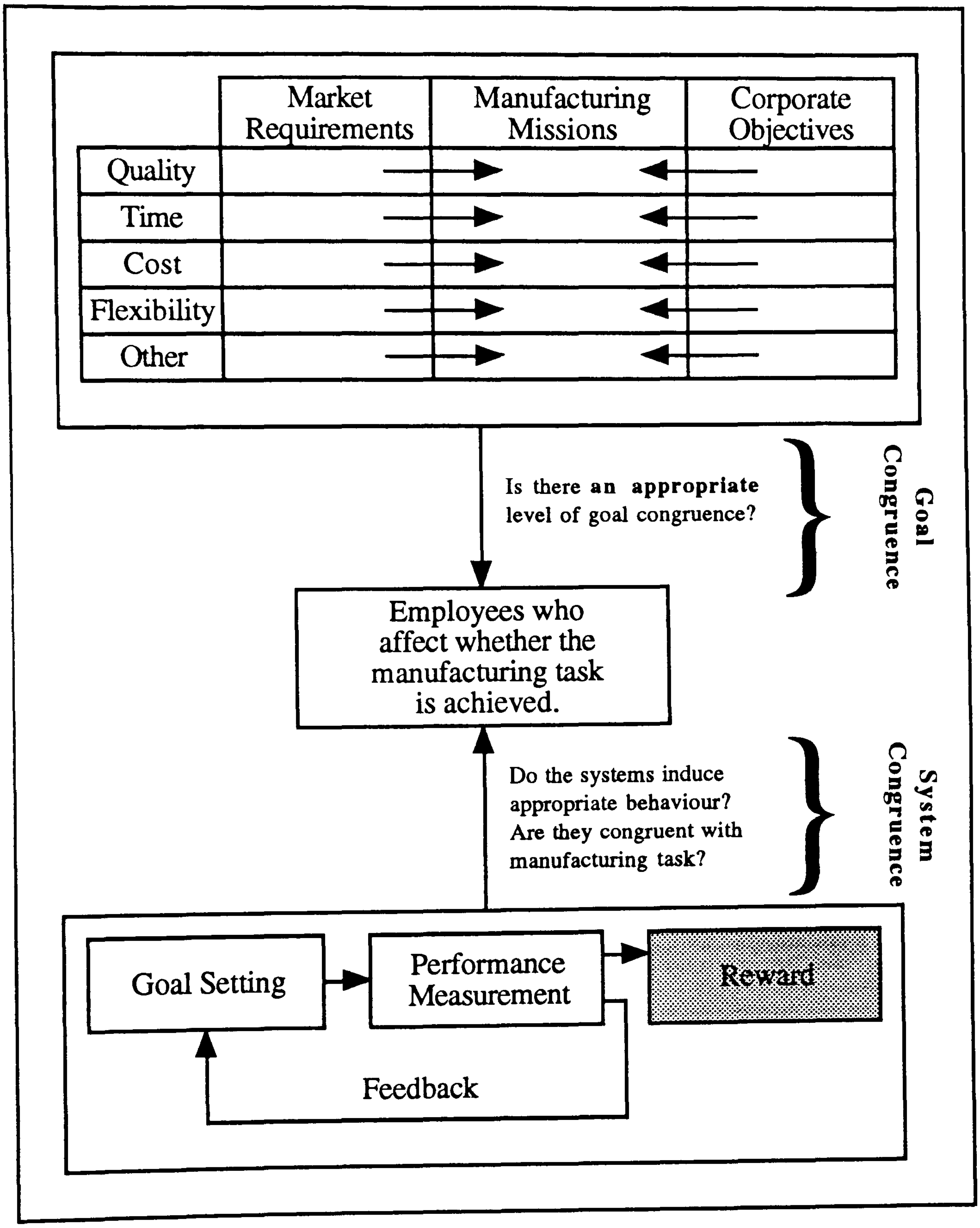
The third improvement that could be made to figure 3.1 relates to the middle box of the framework and the first of the assumptions stated at the beginning of this chapter. Implicit in both of these is the notion that goal congruence is good. It has, however, been suggested that too high a level of goal congruence might inhibit creativity (Pascale, 1990). Furthermore the case studies reported in chapter 6 showed that some differences of opinion in a firm are desirable. Take, for example, figure 6.47. This showed that the supervisors of company D believed that mission G - "people should understand the company objectives" - was far more important than anyone else. During the feedback session there was considerable debate as to whether this mismatch in priorities was a function of the role of the supervisors or an area for concern. On the one hand, the supervisors argued that if they ensured that everyone who worked for them understood the company's objectives, then their jobs would be made far easier. On the other, it was pointed out that if the management team did not think that explaining the company's objectives to the supervisors was important, then they would not spend time doing so, and hence one could question whether the supervisors fully understood the company's objectives and therefore whether they should be trying to explain them to the operatives. Following this debate, however, it was decided that the lack of goal congruence over mission G was indeed a function of the supervisor's role. That is, the management team agreed that a major part of the supervisor's job was to explain the company's objectives and hence it was decided that this was a natural and desirable area of goal incongruence.

This raises the question of what the appropriate level of goal congruence for a firm is. The previous discussion has already shown that it is role specific. In addition it is likely to be a function of the industrial sector within which a firm competes. Take, for example, the electronics industry. Innovation and creativity are the lifeblood of many companies in this industry. Hence if a high level of congruence does indeed inhibit creativity, then perhaps electronics companies should seek to operate with lower levels of goal congruence. On the other hand, take a high volume process company, such as a glass manufacturer. Here, due to the high capital and equipment costs one wants to maximise plant utilisation. Innovation and creativity are likely to be less important than cost minimisation, and hence, in this industry, perhaps a higher level of congruence should be pursued.

During one of the feedback sessions the manufacturing director of company D asked the author what he thought the appropriate level of goal congruence for company D was. The author responded by saying that he believed this was a decision that the company's management had to make for themselves! In a way asking this question belies a lack of understanding of the purpose of the congruence audit. While there might be academic merit in exploring the appropriateness of different levels of congruence for different firms, the purpose of this research was to show that a process which identified areas of incongruence in a firm could provide a novel way of examining why firms may be unable to realise their manufacturing strategies. One of the strengths of the congruence audit was that it did not attempt to be prescriptive. The audit was designed to identify areas of incongruence, but once this had been done it was then up to the management team to decide whether such incongruence was desirable or not.

In terms of the middle box shown in figure 3.1, then, it cannot be assumed that simply because someone affects whether the manufacturing task can be achieved they should necessarily have goals that are highly congruent with it. Indeed as figure 7.1 shows the issue is not; is there a high level of goal congruence, but is there an appropriate level of goal congruence.

Figure 7.1: Modified theoretical framework



There is one other extremely important issue that is not referred to in either figures 3.1 or 7.1, namely the time dimension. The problem here is quite simple - what is important now may not be important next year. As an example let us consider the U.K. television market. Initially the dominant order winning criterion was price and hence the manufacturing task would be cost related. However, in the 1970s the Japanese joined the fray and started to offer higher quality television sets. Over time, this led to a change in customer perception and quality became the dominant order winning criterion. To respond all the companies who decided, or were able, to remain in the market had to improve the quality of their products. Hence the customer's need for higher quality was satisfied and so the market began to compete on price once again, but a high level of product quality remained an order qualifying criterion (Hill, 1980).

Richardson and Gordon (1980) make the same point, albeit from a slightly different perspective, when they argue that as products move through their life cycle the manufacturing task changes. When a product is first introduced, innovation, the ability to cope with frequent design changes, and responsiveness to customer needs will be important. Once the product has become established and the demand for it is increasing then maximising capacity utilisation and minimising lost sales is likely to be important. Finally, once the product reaches maturity it becomes a cash cow and hence the manufacturing task becomes minimise costs.

These observations raise an important question for the research reported in this thesis, namely that if the manufacturing task is likely to change over a period of time, then should effort be expended on ensuring that everyone understands the importance of a specific manufacturing task? It can be argued that not only would this be a waste of resources, but also that there is a danger that if too high a level of congruence exists in a firm no one will question whether the manufacturing task needs to be redefined and hence the company might end up pursuing a strategy which was becoming increasingly inappropriate over time. Alternatively, it can be argued that if one does not try to induce a certain level of congruence in the firm then it is likely that each individual's actions will be directionless and hence the company will be unable to realise any strategy. To an extent these points link back to the question that was discussed earlier, namely what is the appropriate level of goal congruence for a firm, but they also have implications for the manufacturing strategy development process. First they emphasise the importance of ensuring that the management group regularly re-examine whether the prioritisations that they have assigned to the manufacturing missions are still appropriate. Second they reiterate that one should only attempt to define and prioritise the manufacturing missions by product family or customer group. Third they lend support to the thesis that one should not seek to reinforce the importance of the manufacturing missions through the reward systems, because as the manufacturing task changes the systems that the firm uses will have to be modified, and as discussed in chapter five managers would be well advised to avoid having to change their reward systems. Fourth, and perhaps most importantly for this research, as the manufacturing task will change over time the results of the congruence audit will only be valid for a limited period and hence perhaps the audit should be repeated at regular intervals.

7.4: **Summary**

This chapter has explored the assumptions underpinning the research reported in this thesis by reviewing both the strengths and weaknesses of the congruence audit and the conceptual framework which underlies it. Doing this has highlighted three points. First rather than seeking a high level of goal congruence, firms should seek an appropriate level of goal congruence. Second a strong case can be made for not using the firm's systems to reinforce the importance of the manufacturing task. Third the results of any congruence audit have a limited life. Hence perhaps there is a need to repeat it on a regular basis.

CHAPTER 8: CONCLUSIONS

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8.0: Introduction

This research reported in this thesis set out to test the two propositions:

(a) **That a process which can be used to identify areas of either goal or system incongruence (a congruence audit) can be developed.**

(b) **That such a process can be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy.**

In chapter three the conceptual underpinnings of the congruence audit were documented and it was shown how these were grounded in the manufacturing strategy, business strategy, organisational behaviour and organisational culture literature. Chapters four and five described the the development and testing of the goal and system congruence audits. In chapter six the full congruence audit was presented and it was established that this could be used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy. Hence the research aims, documented in chapter 1, were achieved. In chapter seven some of the other issues research raised by this research were discussed and the assumptions underlying the congruence audit were reviewed. The purpose of this chapter is tie together those that have gone before by summarising the findings of the research and identifying areas that require further work.

8.1: Research findings

The main outcome of this research has been to show that the concept of congruence can be; operationalised and used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy. Having said this, however, the research also led to a number of other findings. These are summarised below.

Development and testing of the goal congruence audit

1. The manufacturing task cannot be defined precisely by using the generic terms quality, time, price (cost) and flexibility as each of these consist of a number of sub-dimensions.

2. The manufacturing task is made up of a number of factors (manufacturing missions) which are themselves a function of both the company's objectives and the customer's requirements.

3. Goal incongruence is largely due to the prioritisation of the manufacturing missions rather than their definition.

4. The priorities that an individual attaches to the various manufacturing missions do not vary considerably, even over an extended period of time, unless the interviewee has been subject to a major stimulus, such as company A's management development scheme.

Development and testing of the system congruence audit

5. Managers use the goal setting, performance measurement, feedback and reward systems to reinforce the importance of the manufacturing missions, although it is debatable whether a firm's reward systems should be used.

6. There are two factors which determine to extent to which a given system reinforces the importance of a manufacturing mission; what the system encourages employees to do and how much the system influences their behaviour.

Application of the congruence audit

7. The managers of the small to medium sized companies involved in this

research did not wish to make a distinction between the manufacturing task and the policy decisions. Instead they wanted to make the policy decisions only when the need arose and then define a manufacturing mission which supported their decision.

8. Achieving the shorter term manufacturing missions, such as delivering products on time, was often seen as more important than realising the longer term ones, such as eliminate waste (company D).

9. The level of goal congruence was highest between a firm's senior managers and those employees who worked on the shop floor (companies C and D).

10. The most common reason for a firm being unable to realise its manufacturing strategy was that the actions of the senior managers did not support the manufacturing task (companies C and D).

11. Goal incongruence is not always undesirable. Indeed it can be a function of an individual's role (company D) or their position in the organisation.

12. The firm's non-financial systems have less influence on the priorities of the operatives than they do on those of the supervisors (company C).

13. Relying on financial incentives to motivate people leads to barriers which may inhibit the introduction of future changes in the firm's working practices (companies A, 3 and 4).

14. Firms which do not rely on financial incentives to motivate their employees tend to have a culture based on information sharing and feedback (companies D, 1, 5, 8, 9, 10 and 13).

It should be noted that as this research focuses on the development of a process, the congruence audit, then there are also some findings which relate specifically to the process. These are summarised below.

Process points

1. The definition and prioritisation of the manufacturing missions proved to be a useful team building exercise.

2. The pairwise comparison process provides a suitable technique for prioritising sets of factors (the manufacturing missions and the influence of the firm's systems).

3. The reliability of the data collection process can be enhanced by structuring it formally. This also increases its efficiency.

4. The validity of the data collected can be enhanced through the discussion that can be provoked by immediate visual feedback. This increases it effectiveness.

5. Using questionnaires in an interview provides a means of rapidly collecting a large amount of data while maintaining the flexibility the interview provides.

6. Visual feedback, especially if it compares one person's opinions with those of another, is a powerful way of provoking discussion.

7. The individual interviews are widely understandable. Of the twenty six conducted in companies C and D only two had to be aborted.

8. The consistency ratio generated during the pairwise comparison process provides a useful and independent means of checking the validity of the data that have been collected.

9. The interviewees found it easier to relate to the concept of goal congruence than they did to the more abstract one of system congruence.

10. An external facilitator is necessary as they offer confidentiality, which is a prerequisite given the individual interviewees are going to be asked to explain why their opinions differ from those of the management group.

11. An effective congruence audit can be completed rapidly. Half a days management group discussion and two days interviewing (one hour per interviewee) provides the necessary data. Multiple inputs (either several interviews or a few interviews backed up with other data) enhance one's confidence in the reliability and validity of the process as they enable the facilitator to iron out individual bias.

12. The congruence audit provides a novel means of; (a) defining what a management group believes manufacturing should be doing, (b) identifying what other employees think manufacturing actually is doing, (c) establishing whether any mismatches in perception occur, (d) determining whether such mismatches in perception are a function of the organisation's goal setting, performance measurement, feedback or reward systems, and (e) provoking debate so that the issues raised can be resolved.

8.2: Areas requiring further work

The work reported in this thesis provides the foundations for a variety of future research projects. These are summarised below.

1. Although this work has shown that the concept of congruence can be operationalised and exploited the process that has been developed still requires a skilled facilitator. In some subsequent work, then, it would be useful if the congruence audit could be converted into a more widely

usable process.

2. The findings reported above are based on a limited sample of companies. Due to time constraints it was impossible to apply the congruence audit to a larger sample. Hence there is a need to seek confirmation of some of the findings through further research.

3. The research reported in this thesis focuses on identifying areas of goal and system incongruence which may inhibit a firm's ability to realise its manufacturing strategy. A major topic for future study, then, is the question of how areas of goal and system incongruence which are deemed inappropriate can be reduced or eliminated.

4. One of the questions that the author was often asked during the course of this research was; what is the appropriate level of congruence for a firm. In chapter seven it was suggested that the appropriate level of congruence for a firm might be industry, or even context specific. Future research could seek to explore this.

5. Current developments in the field of Production/Operations Management include the concepts of organisational learning and core competencies. The congruence audit may form the basis of a tool which could be used to further explore both of these concepts. Indeed future research should seek to exploit the generic nature of the process presented in this thesis.

8.3: Summary

This chapter sought to integrate and summarise the work presented in the rest of this thesis. In it both the research findings and areas requiring further work have been discussed.

The objective of this research was to show that the concept of congruence could be operationalised and used to identify some of the reasons why a firm may be unable to realise its manufacturing strategy. This chapter has shown that not only has this objective been achieved, but also that the research reported in this thesis opens a potentially rich seam of future research topics.

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APPENDICES

I: Production/Operations management during the 1980s

II: Analysis of the pairwise comparison data

III: Data collected in companies A and B

IV: Data collected during the shadowing study

V: Data collected in companies C and D

APPENDIX I

Production/Operations Management: Research Process and Content During the 1980s[1]

Abstract

It has been argued that P/OM only emerged as a true functional field of management during the 1980s. If this is the case then one can hypothesise that P/OM research must have changed considerable during the last decade. To test this hypothesis all the articles that were published in the first ten volumes of the International Journal of Operations and Production Management were categorised using a framework based on both the content and process of the research reported. The development of this framework is explained and the data generated from the categorisation process are presented. These data clearly show that during the 1980s the content P/OM research became increasingly of a macro and soft nature.

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Introduction

Production/Operations Management (P/OM), as a functional field of management, has developed rapidly during the last fifteen years. As consumers have become more discerning and competition more intense, manufacturing organisations have been presented with a wide variety of panaceas including; Just-In-Time (JIT), Total Quality Management (TQM), Manufacturing Resources Planning (MRP II), Flexible Manufacturing Systems (FMS) and Computer Integrated Manufacturing (CIM), all of which appear to fall in and out of favour with alarming regularity. In the late 1970s the future for the P/OM community looked bleak and many prominent US business schools were closing down their P/OM courses [1]. By the mid 1980s the new industrial competition, particularly that from Japan, had heightened industrial interest in P/OM to the extent that it was only the lack of qualified teachers which was constraining business schools from offering new P/OM courses [1, 2].

What has happened, then, to the academic discipline of P/OM in the last fifteen years? How has the field developed? Why has it developed so rapidly? What effect has this had on research conducted by the members of the P/OM community? How has their research changed and how is it likely to change in the future? After addressing some of these questions and reviewing some of the papers, from both sides of the Atlantic, that purport to provide research frameworks for P/OM, all the papers published in the first ten volumes of the International Journal of Operations and Production Management (IJOPM) are categorised according to their research content and process. The results of this categorisation exercise are used to highlight some of the interesting trends apparent in the P/OM research conducted during the 1980s.

The Evolution of P/OM

In 1982 Buffa [3] suggested that three overlapping phases of evolutionary development in the field of Production/Operations Management (P/OM) could be identified. These are shown in figure 1.

In the mid 1950s, whilst in its descriptive phase, P/OM was effectively synonymous with the entire field of industrial management and elements from functional disciplines as widely diverse as finance, marketing and personnel management were all included under the P/OM umbrella. By 1961, the year in which P/OM's descriptive phase ended [3], the P/OM community was beginning to disintegrate with some of its members leaving to establish their own functional fields of management. As functional specialisation became more popular those members of the P/OM community who remained found themselves fighting for the survival of a discipline which had been stripped of all but a few techniques: "time and motion study, plant layout, Gantt's production control boards, the simple EOQ model, and simplistic descriptions of how production systems worked" [3, pp. 1].

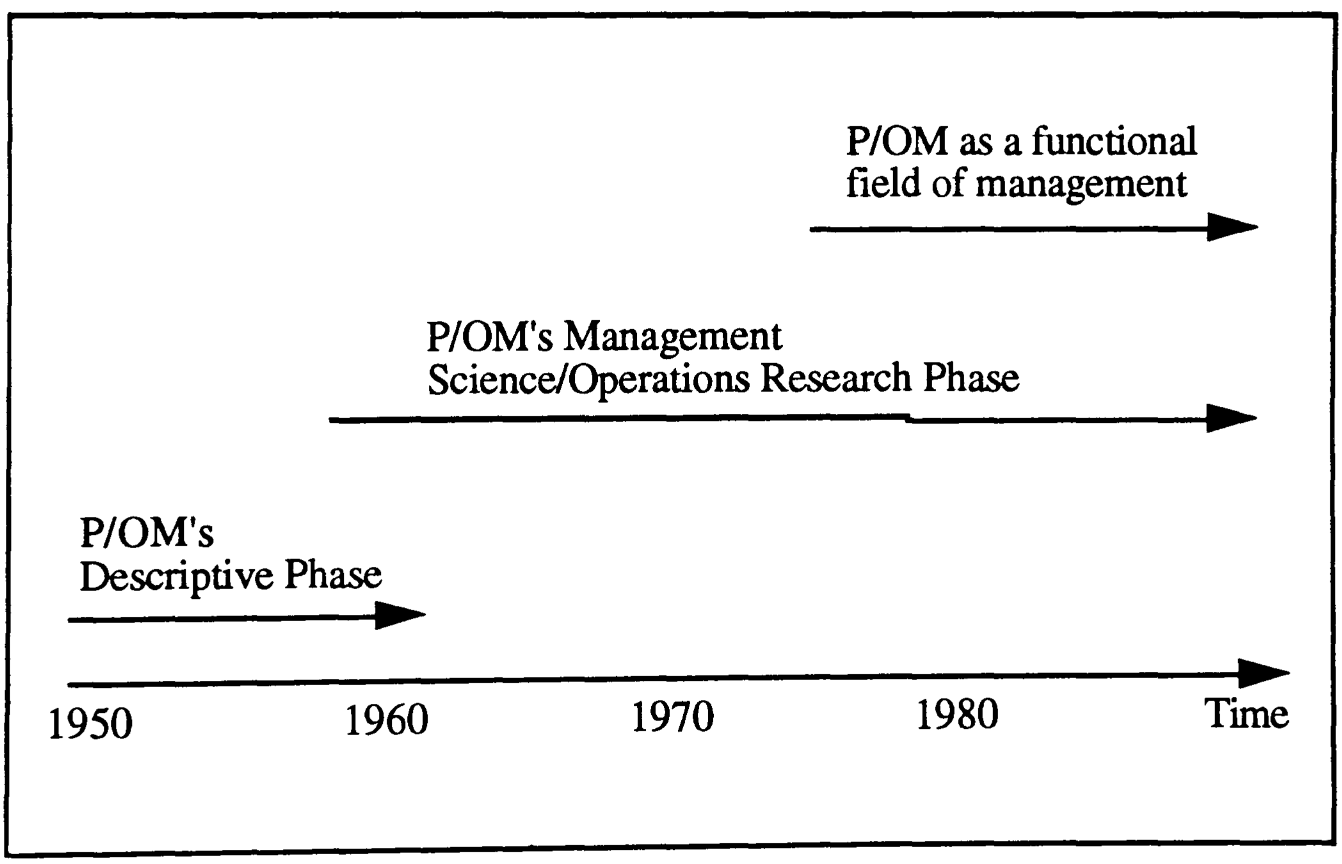
Between 1960 and the late 1970s Management Science/Operations Research (MS/OR) proved to be P/OM's saviour. Indeed when the first twenty five years of the Management Science Journal were reviewed it was found that production management problems were consistently the most studied area (27 percent), followed by finance (8 percent) and marketing (6 percent) [4]. However MS/OR is not, in itself, P/OM and has, to a certain extent, proved to be a false prophet for the field. By the mid 1970s most of the MS/OR techniques that had been developed to solve traditional P/OM type problems were being applied to problems in all the functional fields of management and as these MS/OR techniques became general management tools the members of the P/OM community found that once again they had lost their distinctive competence.

By the early 1980s the future for P/OM was looking much brighter. New P/OM journals, on both sides of the Atlantic, the Journal of Operations Management in the US and the International Journal of Operations and Production Management in the UK, were first published in 1980. Miller et al. [1] observed that in the US the decline in manufacturing competitiveness, particularly the shortcomings in productivity and technological innovation, had lead to a rapid increase in the level of interest expressed in the field and that it was the lack of suitably qualified teachers that was the limiting factor when setting up a new P/OM course. In the UK a similar optimism seemed to sweep through the higher educational establishments and Voss [2] also argued that this was principally due to the now widely recognised new industrial competition, particularly that from Japan.

At about the same time companies that had been hard hit by foreign competition were publicising early results, which later proved to be major turn arounds, that had been achieved through the application of modern production and operations management techniques. For example, in 1983 Harley-Davidson held only 23 percent of the North American market share for the super heavyweight motorcycle. The company had lost almost 77 percent of its market share in fifteen years because of intense competition from Honda, Yamaha, Suzuki and Kawasaki. By the end of 1989 Harley-Davidson's market share was reported as 59 percent and still rising. This impressive turn around has been attributed to three basic operations management principles; employee involvement, statistical operator control and material-as-needed, the Harley-Davidson version of Just-In-Time (JIT) material supply [5].

Buffa's third phase of evolution for operations management, then, began in the early 1980s and he argues that this was when P/OM found itself emerging as a true functional field of management [3]. Since then advanced manufacturing technologies such as; Just-In-Time (JIT), Total Quality Management (TQM), Manufacturing Resources Planning (MRP II), Flexible Manufacturing Systems (FMS) and Computer Integrated Manufacturing (CIM), to name but a few, have all been subject to wide scrutiny. Voss [2], points out, that Production/Operations Management is often confused with either Operations Research or with technology but that it is now really "concerned with the effective selection, application and management of new technologies." Accepting that this is an accurate description of the true functional nature of P/OM then one can hypothesise that research conducted in the field should have changed considerably since P/OM's MS/OR phase. That is not to say that MS/OR techniques will no longer be used but that MS/OR is now a functional discipline in its own right and simply provides one set of tools that a P/OM researcher can use. One of the objectives of this paper is to test this hypothesis by examining all the research published in the first ten volumes of the International Journal of Operations and Production Management. In order to do this it is first necessary to identify what changes in P/OM research one would expect and then to develop a categorisation framework which can be used to identify if such changes actually occurred. In the next section some of the P/OM research frameworks that were published in the early to mid 1980s will be reviewed and the major issues they raise identified. A research categorisation framework, based on the reviewed papers, will then be proposed and used to categorise all the articles that were published in the first ten volumes of the International Journal of Operations and Production Management. The results of the categorisation process will form the basis for a discussion of how both the content and process of P/OM research has changed since the late 1970s.

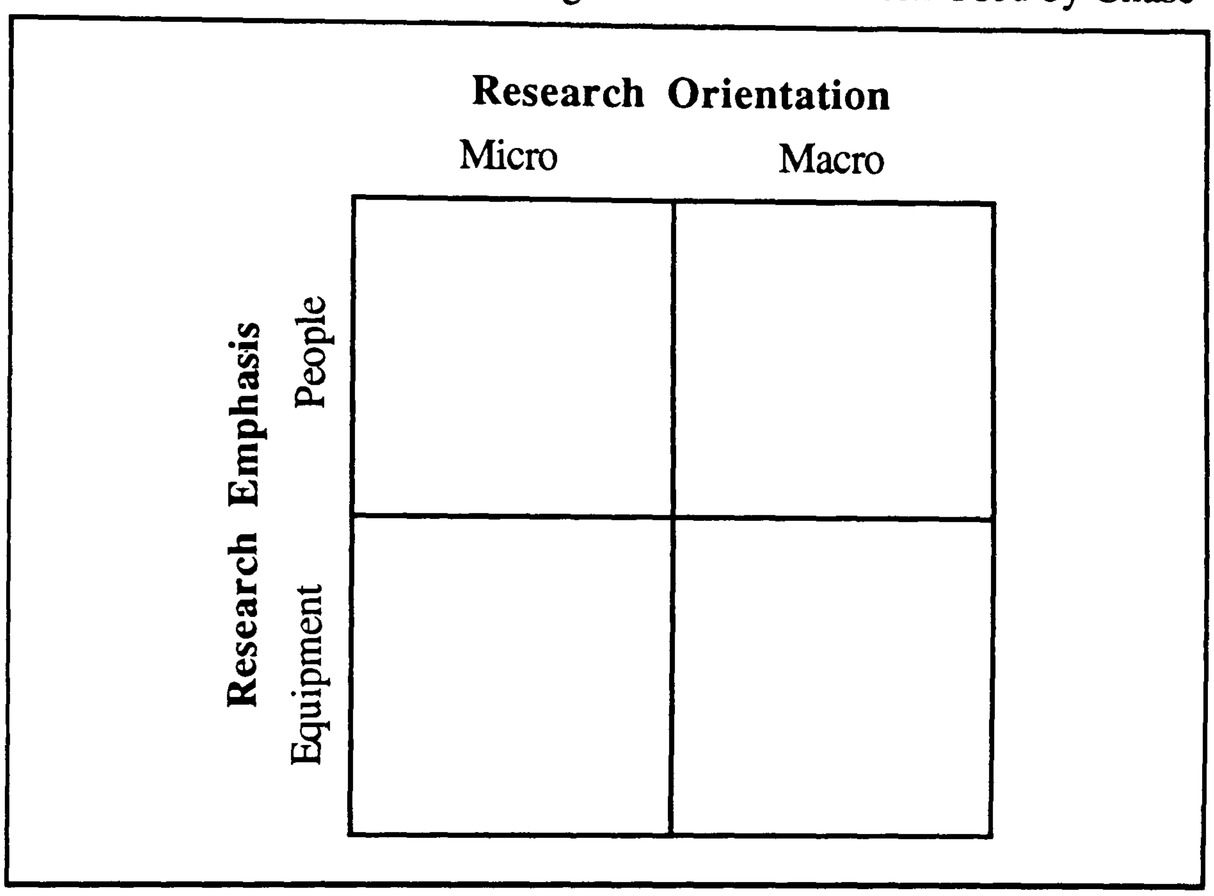
Figure 1: Evolutionary Development of Production/Operations Management



P/OM Research Frameworks

In the first edition of the Journal of Operations Management a superb paper with which to begin a review of P/OM research since the end of its MS/OR phase is presented by Chase [4]. He examined and categorised the 134 P/OM type papers which had been published in volumes 9 and 10 of Decision Sciences, volumes 10 and 11 of AIIE Transactions, volumes 24 and 25 of Management Science and volumes 15, 16 and 17 of the International Journal of Production Research using a framework, based on the two dimensions of research orientation and research emphasis, similar to the one shown in figure 2.

Figure 2: P/OM Research Categorisation Framework Used by Chase



The research orientation dimension refers to the perspective the researchers have adopted. Chase argues that there are two basic categories within research orientation. Either the research focuses on a narrow, well defined, problem and is micro in orientation or it focuses on a larger and usually less well-structured problem and is macro in orientation. The research emphasis dimension, on the other hand, is used to describe to the mechanisation continuum. Chase argues that because all production systems must consist of some combination of people, in terms of their physiological, sociological and physical characteristics, and tangible production equipment (facilities, machines, inventories, transportation devices, etc.) then so must all P/OM research. In his categorisation framework Chase merely uses the end points of the mechanisation continuum and is simply trying to answer the question: does this research focus predominantly on people or equipment?

Of the 134 articles that Chase reviewed and categorised he found that less than 19 per cent described research in which a people emphasis had been adopted. By far the majority of papers, 76 per cent, were based on research that had an equipment emphasis and a micro orientation. The actual breakdown of the categorisations are shown in figure 3.

Figure 3: Results from Chase's Categorisation Exercise

		Research Orientation	
		Micro	Macro
Research Emphasis	People	16 articles (11.9 per cent)	9 articles (6.7 per cent)
	Equipment	102 articles (76 per cent)	7 articles (5.2 per cent)

Chase [4, pp. 10] argues that these results and the data that he had gathered while reviewing and categorising the papers suggest that the "dominant research strategy [up to that time] was problem identification, model formulation, and mathematical and/or computer manipulation of the model." In many ways this is not an unexpected finding, particularly when one considers that Chase was reviewing articles that had been published in 1979 but that were probably based on work conducted between 1975 and 1978, a period that falls well within P/OM's MS/OR phase. What is more relevant to this discussion are Chase's thoughts on both topics for future P/OM research and how the imbalance toward an equipment emphasis and a micro orientation could be redressed.

Firstly Chase suggests that in the future P/OM researchers should consider people in terms of their psycho-social attributes rather than merely as machine minders. Second he argues that more research with a macro orientation should be undertaken. He points out that studies of inventory control and scheduling, which made up 22 per cent and 37 per cent of reported research respectively, were frequently micro in orientation and that they focussed on local rather than global optimisation. Third Chase points out that there appears to be a lack of field based research, particularly studies of a longitudinal nature. Fourth that he found no articles which reported research on purchasing and fifth that papers on manufacturing policy, one of the earliest P/OM subjects [6], rarely appeared outside the Harvard Business Review. Basically, then, Chase appears to have been arguing that increased effort should be expended on research that is macro in orientation, that incorporates the psycho-social attributes of people and that is conducted in the field. How do these recommendations compare with the thoughts of other authors at that time?

Miller et al. [1] say that technology, managing fundamentals and strategic orientation, were the three predominant themes that emerged during a P/OM workshop held in 1980. With respect to technology it was claimed that research seemed to lag behind the industrial state-of-the-art hardware and that software, or thoughtware, such as MRP, Kanban and management developments in the service sector were all poorly understood. It was suggested that one way of rectifying this would be for academics to conduct systematic field based research with an emphasis on collecting, generalising and disseminating information on industrial best practice. An integral part of such research would include investigation of both how to implement new technologies and what benefits could be expected following the implementation.

The second major area that was highlighted was managing fundamentals, or, as Peters and Waterman [7] later called it, sticking to the knitting. As Miller et al.

[1, pp. 566] point out "contrary to popular belief... Japanese auto plants are more productive not because they are highly automated compared to ours but because the Japanese have learned to achieve maximum performance from all system components: equipment, information, and, most of all, people." Once again the emphasis is on field based research, particularly that focussing on both people issues and system integration.

The third and final theme that was identified as important at the workshop was strategic orientation. In support of Skinner [6] and those who have followed him, Miller et al. [1, pp. 567] say that: "manufacturing capabilities, dependent as they are on long lead times and major organisational upheavals, are more important determinants of strategic options than the availability of capital resources. The way things are done is not just a matter of style or even cost effectiveness; it defines the product." Hence they argue that management decisions concerning capacity planning, facilities location and multi-plant production need to be examined to determine their strategic influence. In this case there is a need for field based research with a macro orientation.

Basically, then, both Chase and Miller et al. seem to have a very similar view of how P/OM research should have developed during the 1980s. The predominant themes in the US appear to have been; increased field based research, both in terms of industrial collaboration and exploitation or implementation of existing theory, increased emphasis on the human element, increased research scope, increased research on both purchasing and service operations and the development of a strategic framework for P/OM. If these were the key US themes at the beginning of the 1980s how do they compare with the thoughts of authors based in the UK?

In 1980 the UK's Science and Engineering Research Council (SERC) provided funding for research into manufacturing through its Efficiency of Production System (EPS) panel. Waterlow [8] reports that one of the aims of EPS programme was to encourage research which examined the relationship between various manufacturing sub-systems rather than examining isolated elements. He also explains that the members of the EPS panel regarded working with collaborating companies to be of fundamental importance and that the exploitation and implementation of existing ideas was seen to be more important than the development of entirely new ones. Hence in the early 1980s the SERC were forcing researchers, at least those that wanted funding for their efforts, to explore real macro rather than micro issues in conjunction with industry.

Waterlow [8, pp. 49] defines a manufacturing system as "comprising the equipment, its layout and relationship to the products produced, work practices, planning and control routines, order generation methods, and interfaces with design, marketing and finance." Hence, although similar trends to those observed in the US can be identified, namely the emphasis on collaborative macro research, the parallel issue of increased research on soft systems does not appear to have been explicitly included in the EPS programme. Indeed Waterlow [8, pp. 55] actually says: "research on soft systems in the Programme is likely to concentrate on how to handle variety with short lead times, and to relate more closely to new process and computer technologies (including software) in order to overcome some of the inherent difficulties in this type of research. Topics which will be covered superficially, or not at all, which are of potential interest to P/OM researchers, are manufacturing policies, management styles, organisational structures, and performance measurement." Of course, it may be that members of the SERC assumed that such subjects were funded under research programmes sponsored by the Economic and Social Research Council (ESRC), formerly the Social Science Research Council.

In 1982 the UK's Social Science Research Council (SSRC) commissioned a review of current P/OM research. Lawrence [9] was given the task of studying research on the man management aspects of P/OM, particularly in terms of who became production managers, what their expected career path was and what qualifications they had, etc. While Voss [2] examined the wider P/OM issues. As part of his study Voss organised a two day workshop which was attended by over fifty P/OM researchers and teachers, and where a variety of papers on current research interests were presented. Coupling information collected during discussions at the workshop with the results of a wider survey Voss identified the ten major P/OM topic areas that were of interest to UK academics in the early 1980s. These were; manufacturing policy, measurement of performance, international comparisons, technology (e.g. CAD/CAM, FMS, robotics, CIM), management of technological change, application of computers, production planning and inventory control, quality management, quantitative approaches and service operations management. In his paper Voss was keen to emphasise the managerial nature of P/OM. Specifically, he argued, that P/OM research was required in the following areas; manufacturing policy, management of technology, foreign manufacturing practices, service operations, purchasing and quality.

In summary, then, one can identify a number of parallel themes in the papers from both the US and the UK that were published in the early 1980's and that purported to present P/OM research frameworks. The major theme seems to have been that P/OM was now emerging as a functional field of management in its own right. Because of this research on manufacturing policy, which could provide an integrative theme for all P/OM research, was seen as fundamentally important. In terms of the content of research, that is the question of **what** should be examined, the major themes appear to have been that emphasis on the softer elements of P/OM should be increased and that more research of a macro nature should be undertaken. When one considers the research process, that is **how** should the work be conducted, the principal themes appear to be more collaboration with industry and an increase in emphasis on implementation and exploitation of existing ideas, rather than development of entirely new ones. In the next section the research dimensions of content and process are used to develop categorisation frameworks. These frameworks were used to categorise all the articles that were published in the first ten volumes of the International Journal of Operations and Production Management (IJOPM) in an attempt to see if the P/OM community has lived up to those early challenges which were laid down in the research frameworks which have been reviewed. The results of the categorisation process follow sections on the development and use of the categorisation frameworks.

Development of the Categorisation Frameworks

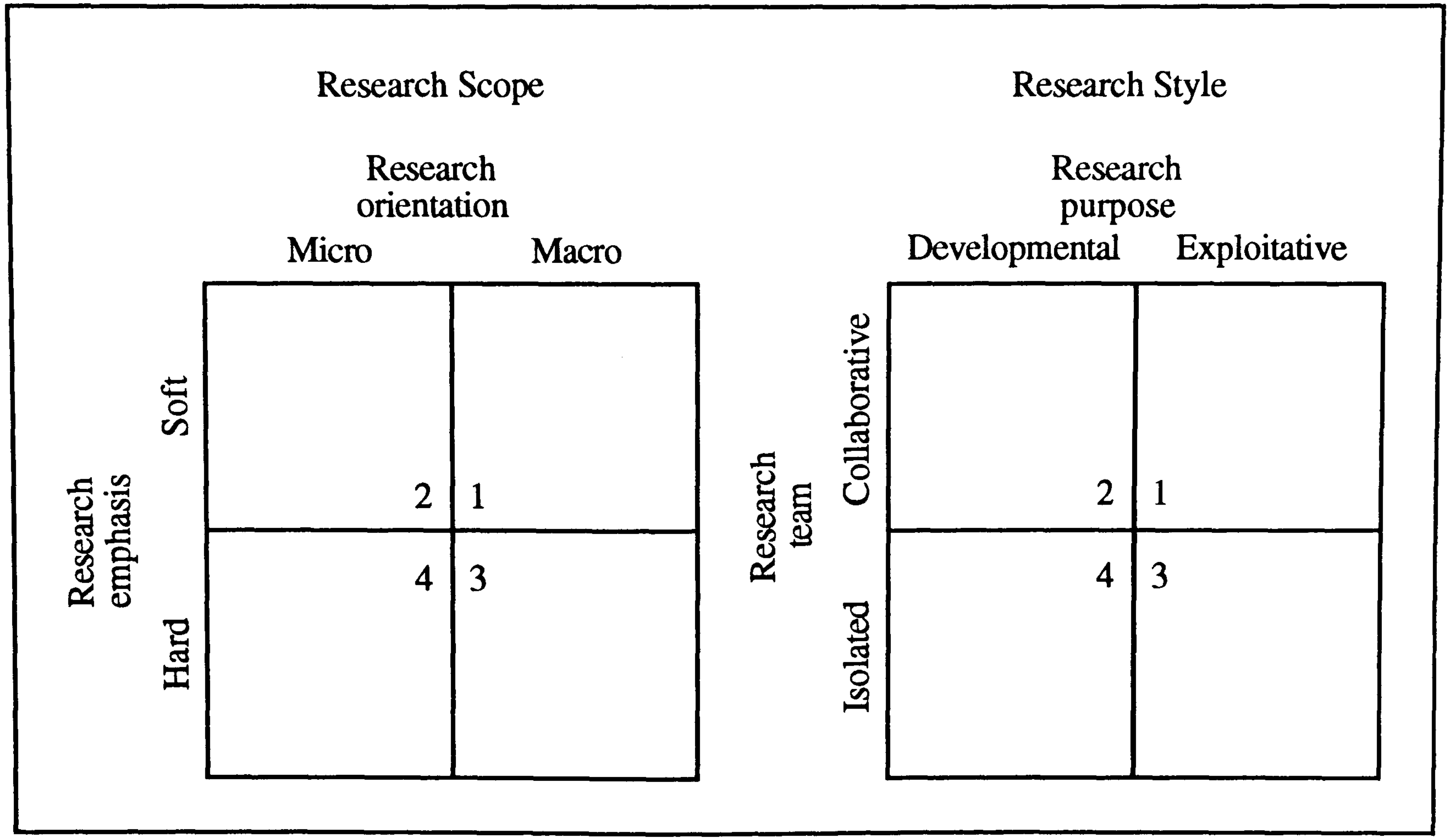
The major themes identified in the previous section can be split into two categories. The first, which reflects the research scope or content, addresses the issue of **what** is being studied? Is it macro or micro in orientation? Does it emphasise the hard or soft elements of P/OM? This question of research scope can be examined using a categorisation framework similar to the one developed by Chase [4]. One of the major advantages of using such a framework is that an approximate comparison can be made between the two studies. However it is acknowledged that because different individuals have categorised the different papers one cannot assume that the results are directly comparable.

The second set of themes can be categorised according to the research process, or style, adopted. In this case the question that is being addressed is **how** (and why) was this research conducted? Was it collaborative? Was the research designed to produce new theories or to identify ways of exploiting existing ideas? Figure 4 shows both of these categorisation frameworks with their associated keys.

Use of the Categorisation Frameworks

As can be seen in figure 4 each quadrant of the categorisation frameworks has been labelled 1, 2, 3 or 4. The quadrant labelled 4 is the one which most closely represents the MS/OR type research philosophies identified by Chase [4]. The quadrant labelled 1 is the one into which an increasing amount of P/OM research should fall if the predictions made by the authors of the P/OM research frameworks that have been reviewed have come true. As far as was possible the following guidelines were followed when categorising each article.

Figure 4: Categorisation Frameworks Used for this Research



Research Scope Categorisation Framework

Research Orientation:

The research orientation is either macro or micro. All papers that referred to an isolated problem, such as how to schedule a manufacturing cell, or how to select a computer aided design (CAD) system, were categorised as having a micro orientation. An example of a paper having a macro orientation would be one which focussed on issues such as how will the implementation of a CAD system help integrate the design and manufacturing functions?

Research Emphasis:

Papers based primarily on managerial issues, such as the JIT manufacturing philosophy, job design and quality circles were categorised as having a soft emphasis. At the other extreme reports which focussed on machine tools, layout of plant and statistical process control were classified as hard.

Research Style Categorisation Framework

Research Purpose:

If the objective of the research was to produce a new scheduling algorithm or to design a new method of manufacture then the research purpose was classified as developmental. If, on the other hand, the research reported studies of existing technology or industrial practice and the emphasis was on exploitation of the ideas then the research was categorised as exploitative.

Research Team:

If the research was conducted in partnership with industry then it was classified as collaborative. If it were conducted in a laboratory with little or no external input then it was categorised as isolated.

Basically then during the categorisation process the following four questions were being addressed:

-Does the research have a broad or narrow orientation?

-Does the research predominantly focus on the soft or hard P/OM issues?

-Is the research pure or does it produce some practical conclusions that will help industrialists implement advanced manufacturing technologies?

-Is the research team multi-disciplinary?

Because of the inherent subjectivity of this method justifications for the categorisation of all the papers in volume 1, number 1 of the International Journal of Operations and Production Management have been provided below. It is hoped that this will offer the reader some insight into the thought processes that accompanied the categorisation of the papers.

Justification For Categorisations

Paper 1: Hill [10]

The title of this paper, Manufacturing Implications in Determining Corporate Policy, suggests that the research will have a macro orientation. In the first section of the paper, Hill explains that he asked two groups of senior managers what they understood by the phrase manufacturing policy. Hence one can conclude that the research team is multi-disciplinary, that is it involves both academics and industrialists. By scanning through the rest of the paper it can be seen that Hill goes on to examine why manufacturing directors do not get involved with the development of manufacturing policy and ultimately a framework showing how manufacturing policy issues are related to corporate decisions is presented. This framework lies towards the soft end of the mechanisation continuum and is certainly designed for exploitation. Hence Hill's paper is categorised as 1 for both research scope and research style.

Paper 2: Ray [11]

This paper, entitled Assessing UK Industry's Inventory Management Performance, immediately suggests collaborative or multi-disciplinary research, possibly through the use of surveys. On reviewing the paper, however, it becomes apparent that Ray has based his paper on a variety of publicly available reports. The topic is micro in perspective, in that Ray considers inventory alone. The emphasis of the research, inventory management, is relatively hard and while Ray presents a convincing case which emphasises the importance of good inventory management there are few practical suggestions as to what one should do. Therefore this paper is categorised as a 4 for both research scope and research style.

Paper 3: Sassani and Rathmill [12]

The title of this paper is An Evaluation of the Effects of Skill Variety and Labour Mobility in the Operation of Industrial Man/Machine Groups Using a Simulation Model. The synopsis specifically mentions collaboration with a company and operator skills. Hence one's immediate reaction is that the research team is multi-disciplinary and the research emphasis is soft. However the research was actually based on a simulation in which it has been assumed that the humans are merely machine minders. So the initial research emphasis categorisation of soft is changed to hard. Sassani and Rathmill say that their simulation model was useful for the managers in the firm, but that a high level of skill was required before one could use it. Hence the research purpose appears to have been developmental rather than exploitative. Finally the problem addressed was that of how to assign workers to machines which in itself is a fairly specific and hence micro problem. The final categorisations for Sassani and Rathmill's paper, then, are a 4 for research scope and a 2 for research style.

Paper 4: Wright [13]

In his paper, Wright argues that purchasing is a somewhat neglected function that has been ignored by both academics and industrialists. The paper is abstract, developmental and the research is isolated. Hence it is categorised as a 4 for research style. In terms of research scope the paper is macro in orientation and fairly soft, and hence categorised as a 1.

Paper 5: Fortuin [14]

Fortuin's paper, The All-Time Requirement of Spare Parts for Service After Sales - Theoretical Analysis and Practical Results, focuses on the, fairly narrow or micro, problem of identifying the all-time requirement for replacement components. He develops a mathematical model and presents data from an "average case". The paper is categorised as 4 for both research scope and research style.

Paper 6: Hollier [15]

The title of this paper, The Grouping Concept in manufacturing, suggests that the research emphasis will be hard and this proves to be the case. In his conclusions Hollier suggests that "a wider view should be taken of the concept of grouping in the design and operation of production systems as a major step in simplifying their complexity" [15, pp. 77]. Hence the orientation of the research is macro. This gives a final classification for the research scope of 3. The research style is categorised as a 3. It is isolated because Hollier is using his own opinions to explain the concept of grouping and exploitative because the paper is written in a style which explains the concepts and benefits of grouping.

Results from the Categorisation Process

Figures 5 and 6 show the broad trends during the 1980s in terms of both the content and process of the P/OM research published in the International Journal of Operations and Production Management (IJOPM). At the beginning of the decade as Chase [4] suggests there was a tendency to conduct, or at least report, research on hard topics with a micro orientation. (73% of papers published in volume 1 of the IJOPM fell into this category. This is comparable with the figure 76% that Chase reports.) However over the following few years more research on softer and macro topics was reported and by the middle of the decade articles which focussed on the macro/soft P/OM topics were more common in the IJOPM than those that focussed on micro/hard issues.

With respect to the research process the picture is somewhat less clear. Isolated/developmental research appears to be the most common. In fact over the ten year period 41% of papers published in the IJOPM fell into this

Figure 5: Research Content of Papers Published in the IJOPM

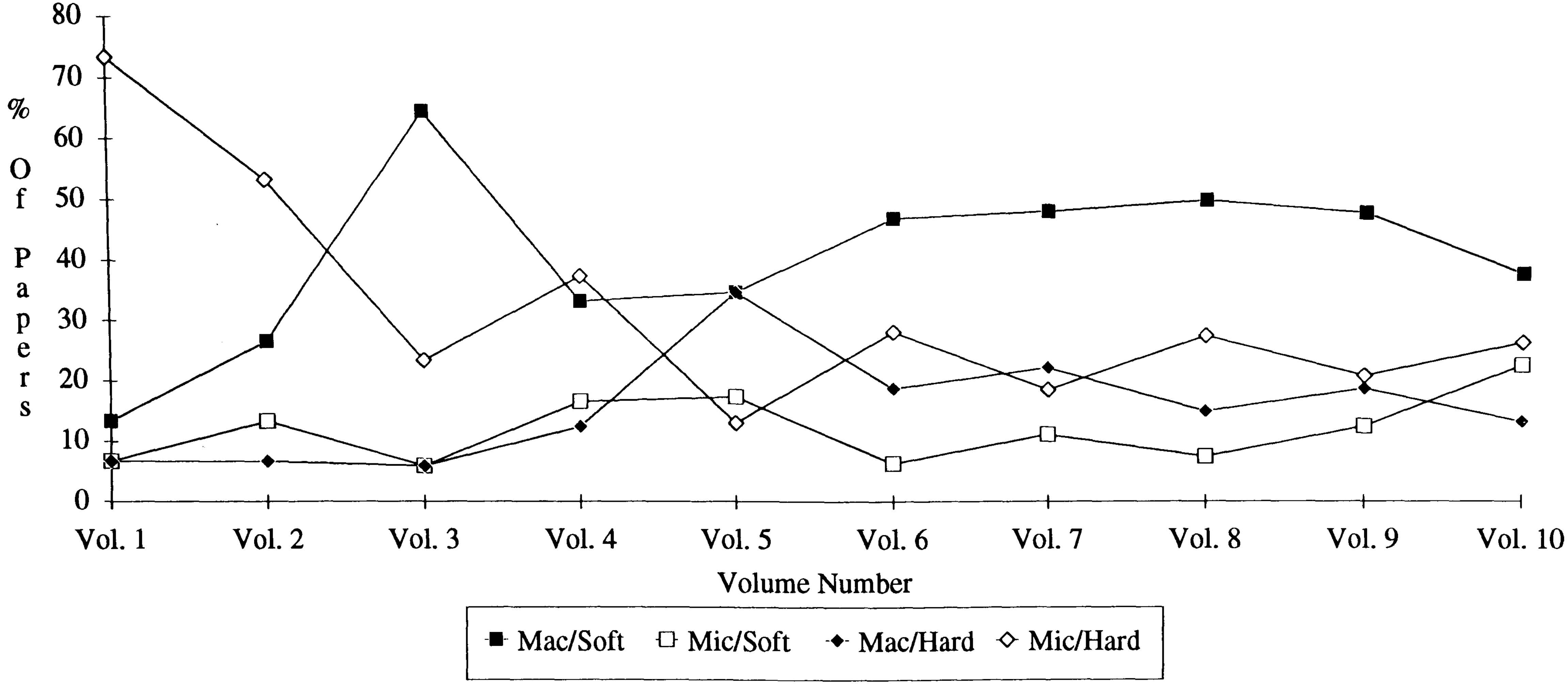
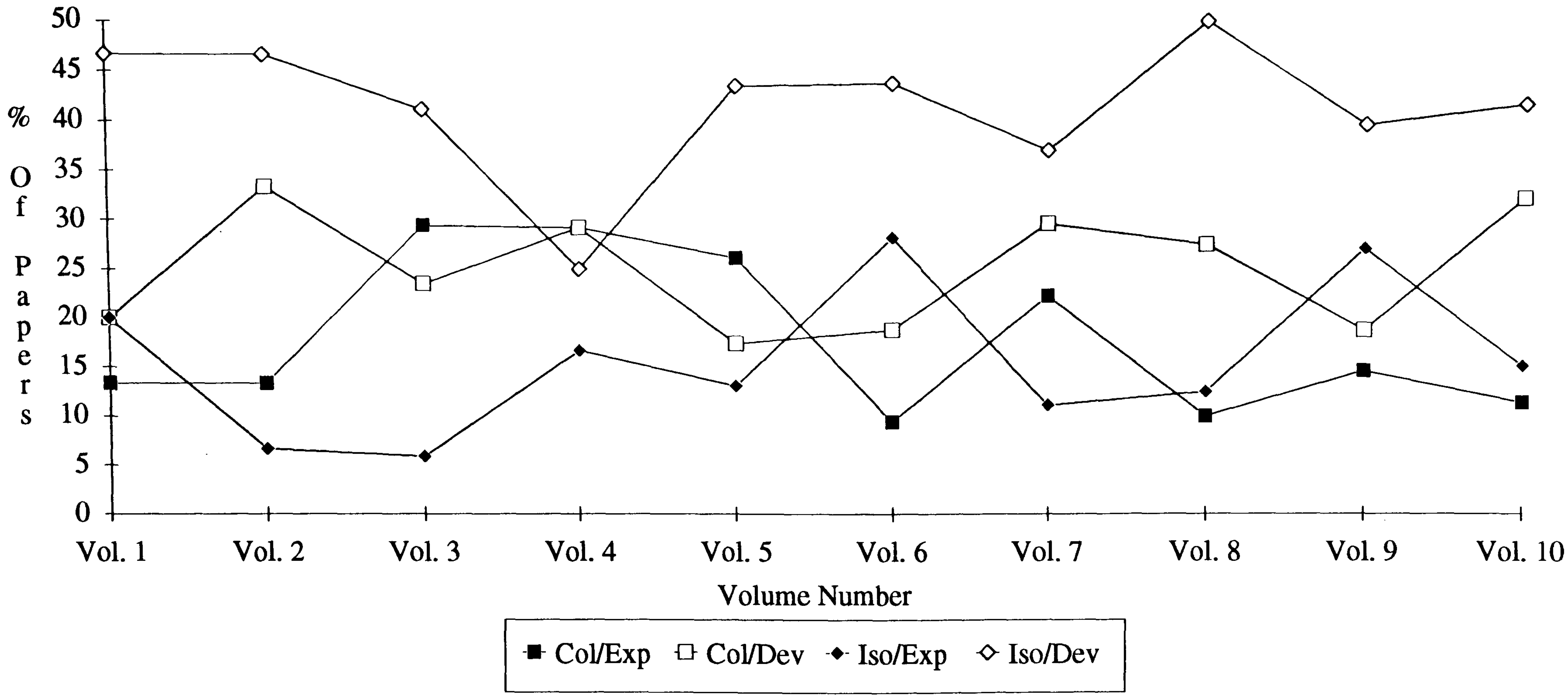


Figure 6: Research Process Used in Papers Published in the IJOPM



category. Next most common is collaborative/developmental research (25%), followed by collaborative/exploitative (18%) and finally isolated/exploitative (16%). However, as can be seen in figure 6 the research processes vary substantially on an annual basis and it appears that the choice of research process has not been subject to the same pressures as research content. Perhaps this is because the research process adopted is a question of personal preference, while the research content is subject to the current mindset of the members of a research community. It is, of course, unrealistic to suggest that any one research process is better than any other. It is vital that as a community P/OM researchers develop techniques which can be exploited but at the same time if there were no new pure research then no new techniques would be generated. In fact if there were no pure research the role of the members of the P/OM community would be to report and disseminate information on existing best practice, a role that one could argue might be better suited to journalists than academics.

Conclusions

The principal purpose of this paper was to examine how the radical changes that have taken place in the P/OM field during the last fifteen years have affected both the content and process of the P/OM research reported in the IJOPM. After describing P/OM's evolutionary development and identifying the predicted changes in P/OM research all of the papers published in the first ten volumes of the International Journal of Operations and Production Management were categorised according to the research they reported. The data generated from this exercise showed that while there was a steady trend during the 1980s towards increased macro/soft research and decreased micro/hard research, there were no similar trends with respect to the research processes used.

One issue that has not yet been addressed is the question of the future of P/OM research. In 1980 Chase [4] wrote:

"research on research is often a perilous undertaking, with the list of caveats exceeding the list of results. This paper is no exception. Small sample sizes and judgment calls do not provide a feeling of security, and proposing what an entire field "should" consider smacks of hubris and perhaps a little glue sniffing."

It is freely acknowledged that these comments apply to this paper. Practical results are limited, as is the sample size, because only papers published in the IJOPM have been included. Because of this one could argue that the results reported reflect the editorial policy of the journal and do not relate to developments in the P/OM field as a whole. As a counter arguement one could suggest that the papers published in the IJOPM should be reasonably representative of P/OM research as a whole and that little, if anything, would be gained by repeating the same process with different journals. In the end, however, the important point is not so much the results reported but the issue they raise. During the 1980s the amount of research with a macro/soft content appears to have increased at the expense of that with a micro/hard content as predicted in the P/OM research frameworks reviewed. Why then has the same not happened with respect to the collaborative/exploitative research process? Is it because the choice of research process is a function of personal preference? Is it because conferences, papers and seminars often focus on the issue of research content rather than the process used? Perhaps one of the key questions for the 1990s is not only what but also how P/OM research should be conducted?

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APPENDIX II

Analysis of pairwise comparison data

Introduction

This appendix explains how the raw data collected during the pairwise comparison process are converted into; a set of preference weightings and a consistency ratio. The data used in the example were gathered during an interview with the manufacturing director of company A. The matrix shown in figure 1 was produced as a result of the pairwise comparison process.

Figure 1: Data Produced During the Pairwise Comparison Process

	Perceived quality	Performance quality	Due date performance	Selling price	New product flexibility	Rate of product introduction	Serviceability	Aesthetics
Perceived quality	1	1/3	3	1	2	2	3	1
Performance quality	3	1	3	1	2	2	4	1
Due date performance	1/3	1/3	1	1/2	1/4	1	1	1/2
Selling price	1	1	2	1	1	2	2	1
New product flexibility	1/2	1/2	4	1	1	3	1	1
Rate of product introduction	1/2	1/2	1	1/2	1/3	1	1	1/2
Serviceability	1/3	1/4	1	1/2	1	1	1	1/2
Aesthetics	1	1	2	1	1	2	2	1

Step 1: Normalise the data in each column

Calculate the sum of each column and then divide every entry in the column by the appropriate sum. This results in the matrix shown in figure 2.

Figure 2: Normalised Pairwise Comparison Matrix

	Perceived quality	Performance quality	Due date performance	Selling price	New product flexibility	Rate of product introduction	Serviceability	Aesthetics
Perceived quality	0.13	0.07	0.18	0.15	0.23	0.14	0.2	0.15
Performance quality	0.39	0.2	0.18	0.15	0.23	0.14	0.27	0.15
Due date performance	0.04	0.07	0.06	0.08	0.03	0.07	0.07	0.08
Selling price	0.13	0.2	0.12	0.15	0.12	0.14	0.13	0.15
New product flexibility	0.07	0.1	0.24	0.15	0.12	0.21	0.07	0.15
Rate of product introduction	0.07	0.1	0.06	0.08	0.04	0.07	0.07	0.08
Serviceability	0.04	0.05	0.06	0.08	0.12	0.07	0.07	0.08
Aesthetics	0.13	0.2	0.12	0.15	0.12	0.14	0.13	0.15

Step 2: Calculate the preference weightings for each factor

Calculate the relative importance of each factor by working averaging each row. Table 1 shows these values for the factors which the manufacturing director of company A identified as externally important.

Table 1: The Preference Weightings for each of the Factors

Factors	Importance	Percentage
Perceived quality	0.157	15.7%
Performance quality	0.215	21.5%
Due date performance	0.061	6.1%
Selling price	0.144	14.4%
New product flexibility	0.138	13.8%
Rate of product introduction	0.070	7.0%
Serviceability	0.070	7.0%
Aesthetics	0.144	14.4%

Step 3: Multiply the calculated preference weighting by the values in the original pairwise comparison matrix

In this example the original pairwise comparison matrix, figure 1, was an eight by eight matrix. Multiplying this by the matrix in table 1 gives the data shown in table 2.

Table 2: Original Pairwise Comparison Multiplied by the Weightings

Factors	Value
Perceived quality	1.328
Performance quality	1.856
Due date performance	0.504
Selling price	1.201
New product flexibility	1.137
Rate of product introduction	0.578
Serviceability	0.590
Aesthetics	1.201

Step 4: Divide each entry in table 2 by the corresponding entry in table 3

The next step is to divide each element in table 2 by the corresponding element in table 1. The new data that this step generates is shown in table 3.

Table 3: Data in Table 2 Divided by Appropriate Factor Weighting

Factors	Value
Perceived quality	8.442
Performance quality	8.626
Due date performance	8.208
Selling price	8.343
New product flexibility	8.215
Rate of product introduction	8.302
Serviceability	8.402
Aesthetics	8.343

Step 5: Calculate the consistency index

The consistency index is calculated by taking the average of the one by eight matrix shown in table 3, that is 8.360 and using it in the following formula:

$$\text{Consistency index} = \frac{(\text{Average - n})}{(\text{n-1})}$$

where n is the number of factors in the original matrix, in this case eight. Hence for this example, the consistency index is 0.051.

Step 6: Calculate the consistency ratio

Saaty (1980) provides a table of consistency indices calculated from randomly generated matrices. Dividing the calculated consistency index by the Saaty's average random index (R.I.) gives the consistency ratio, which Saaty suggests should be less than ten percent to avoid any risk of rank reversal[1]. In this example the consistency ratio is actually 3.65% which suggests that the interviewee had provided very consistent responses during the pairwise comparison process.

1 Rank reversal is where the order of two or more factors are reversed because of inconsistency in the decision maker's pairwise comparisons.

APPENDIX III

Data collected in companies A and B

Factors Identified as Internally Important by the Managers of Company A

Consistency Ratio:		12%	14%
Date:		16/1/91	17/1/91
		Marketing	Manufacturing
		Director	Director
Performance	Q1	25%	26%
Features	Q2		
Reliability	Q3	9%	
Conformance	Q4	14%	
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8	16%	
Humanity	Q9		
Value	Q0		
Manufacturing Lead Time	T1		10%
Rate of Product Introduction	T2		
Delivery Lead Time	T3		20%
Due Date Performance	T4	11%	
Frequency of Delivery	T5		
Manufacturing Cost	C1		13%
Value Added	C2	11%	
Selling Price	C3		
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3		
Modification	F4		
Deliverability	F5		4%
Volume	F6	8%	12%
Product Mix	F7	6%	8%
Resource Mix	F8		8%

Factors Identified as Internally Important by the Managers of Company A

Consistency Ratio:		9%	16%
Date:		17/1/91	16/1/91
		Production	Head of
		Manager	Dept. 1
Performance	Q1	17%	
Features	Q2		
Reliability	Q3		18%
Conformance	Q4		6%
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8	9%	33%
Humanity	Q9	4%	
Value	Q0		
Manufacturing Lead Time	T1		21%
Rate of Product Introduction	T2		2%
Delivery Lead Time	T3	15%	
Due Date Performance	T4	22%	11%
Frequency of Delivery	T5		
Manufacturing Cost	C1	21%	7%
Value Added	C2		
Selling Price	C3		
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3	6%	
Modification	F4		
Deliverability	F5		
Volume	F6	6%	
Product Mix	F7		
Resource Mix	F8		2%

Factors Identified as Internally Important by the Managers of Company A

Consistency Ratio:		9%	15%
Date:		27/2/91	16/1/90
		Head of Dept. 2	Foreman 1
Performance	Q1		
Features	Q2		
Reliability	Q3		
Conformance	Q4	19%	10%
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8		
Humanity	Q9		
Value	Q0		
Manufacturing Lead Time	T1	15%	10%
Rate of Product Introduction	T2		
Delivery Lead Time	T3		
Due Date Performance	T4	16%	15%
Frequency of Delivery	T5	17%	
Manufacturing Cost	C1	13%	33%
Value Added	C2		
Selling Price	C3		
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		3%
Output Quality	F2		
New Product	F3	7%	12%
Modification	F4	7%	
Deliverability	F5		9%
Volume	F6		
Product Mix	F7		
Resource Mix	F8	5%	8%

Factors Identified as Internally Important by the Managers of Company A

Consistency Ratio:		7%	
Date:		30/11/90	
		Foreman 2	
Performance	Q1	17%	
Features	Q2		
Reliability	Q3		
Conformance	Q4		
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8		
Humanity	Q9	6%	
Value	Q0		
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3	17%	
Due Date Performance	T4	15%	
Frequency of Delivery	T5		
Manufacturing Cost	C1	5%	
Value Added	C2		
Selling Price	C3		
Running Cost	C4	17%	
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3	4%	
Modification	F4		
Deliverability	F5		
Volume	F6		
Product Mix	F7		
Resource Mix	F8	18%	

Factors Identified as Externally Important by the Managers of Company A

Consistency Ratio:		11%	4%
Date:		16/1/91	17/1/91
		Marketing	Manufacturing
		Director	Director
Performance	Q1	41%	22%
Features	Q2		
Reliability	Q3	5%	
Conformance	Q4	16%	
Technical Durability	Q5		
Serviceability	Q6		7%
Aesthetics	Q7		14%
Perceived Quality	Q8	17%	
Humanity	Q9		
Value	Q0		16%
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		7%
Delivery Lead Time	T3		
Due Date Performance	T4	5%	6%
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3	3%	14%
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3		14%
Modification	F4		
Deliverability	F5	6%	
Volume	F6	7%	
Product Mix	F7		
Resource Mix	F8		
Safety	M		

Factors Identified as Externally Important by the Managers of Company A

Consistency Ratio:		4%	14%
Date:		17/1/91	16/1/91
		Production	Head of
		Manager	Dept. 1
Performance	Q1	31%	25%
Features	Q2		
Reliability	Q3	16%	18%
Conformance	Q4		
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8	5%	
Humanity	Q9		
Value	Q0	16%	
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3		10%
Due Date Performance	T4	13%	13%
Frequency of Delivery	T5	4%	
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3	12%	2%
Running Cost	C4		
Service Cost	C5		6%
Material Quality	F1		
Output Quality	F2		
New Product	F3		5%
Modification	F4	5%	
Deliverability	F5		
Volume	F6		
Product Mix	F7		
Resource Mix	F8		
Safety	M		22%

Factors Identified as Externally Important by the Managers of Company A

Consistency Ratio:		9%	14%
Date:		27/2/91	16/1/90
		Head of	Foreman 1
		Dept. 2	
Performance	Q1		35%
Features	Q2		
Reliability	Q3		13%
Conformance	Q4		
Technical Durability	Q5		
Serviceability	Q6	17%	9%
Aesthetics	Q7	5%	3%
Perceived Quality	Q8	23%	22%
Humanity	Q9		
Value	Q0		
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3		3%
Due Date Performance	T4	18%	6%
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3	9%	9%
Running Cost	C4		
Service Cost	C5	12%	
Material Quality	F1		
Output Quality	F2		
New Product	F3		
Modification	F4	8%	
Deliverability	F5		
Volume	F6		
Product Mix	F7	7%	
Resource Mix	F8		
Safety	M		

Factors Identified as Externally Important by the Managers of Company A

Consistency Ratio:		7%	
Date:		30/11/90	
		Foreman 2	
Performance	Q1		
Features	Q2		
Reliability	Q3	10%	
Conformance	Q4		
Technical Durability	Q5		
Serviceability	Q6	8%	
Aesthetics	Q7		
Perceived Quality	Q8	12%	
Humanity	Q9		
Value	Q0	17%	
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2	11%	
Delivery Lead Time	T3		
Due Date Performance	T4	13%	
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3	18%	
Running Cost	C4		
Service Cost	C5	12%	
Material Quality	F1		
Output Quality	F2		
New Product	F3		
Modification	F4		
Deliverability	F5		
Volume	F6		
Product Mix	F7		
Resource Mix	F8		
Safety	M		

Factors Identified as Internally Important by the Managers of Company A
Taking their Definitions into Account

Consistency Ratio:	12%	14%
Date:	16/1/91	17/1/91
	Marketing	Manufacturing
	Director	Director
Product Performance	25%	
Product Features		
Product Reliability	9%	
Company Reliability		
Conformance	14%	
Technical Durability		
Technological Durability		
Serviceability		
Aesthetics		
Product Image		
Company Image	16%	
Customer Relations		
Employee Relations		
Value for Money		
Manufacturing Lead Time		10%
Rate of Product Introduction		
Delivery Lead Time		20%
Internal Due Date Performance		26%
External Due Date Performance	11%	
Frequency of Delivery		
Manufacturing Cost		13%
Value Added	11%	
Selling Price		
Product Running Cost		
Product Service Cost		
Product Warranty Cost		
Incoming Material Quality		
Output Product Quality		
New Product Introduction		
Product Modification		
Delivery Flexibility		4%
Volume Flexibility	8%	12%
Product Mix Flexibility	6%	8%
Resource Mix Flexibility		8%

Factors Identified as Internally Important by the Managers of Company A
Taking their Definitions into Account

Consistency Ratio:	9%	16%
Date:	17/1/91	16/1/91
	Production	Head of
	Manager	Dept. 1
Product Performance		
Product Features		
Product Reliability		18%
Company Reliability		
Conformance		6%
Technical Durability		
Technological Durability		
Serviceability		
Aesthetics		
Product Image	9%	33%
Company Image		
Customer Relations		
Employee Relations	4%	
Value for Money		
Manufacturing Lead Time		
Rate of Product Introduction		2%
Delivery Lead Time	15%	
Internal Due Date Performance	17%	11%
External Due Date Performance	22%	21%
Frequency of Delivery		
Manufacturing Cost	21%	7%
Value Added		
Selling Price		
Product Running Cost		
Product Service Cost		
Product Warranty Cost		
Incoming Material Quality		
Output Product Quality		
New Product Introduction	6%	
Product Modification		
Delivery Flexibility		
Volume Flexibility	6%	
Product Mix Flexibility		
Resource Mix Flexibility		2%

Factors Identified as Internally Important by the Managers of Company A
Taking their Definitions into Account

Consistency Ratio:	9%	15%
Date:	27/2/91	16/1/90
	Head of	Foreman 1
	Dept. 2	
Product Performance		
Product Features		
Product Reliability		
Company Reliability		
Conformance	19%	10%
Technical Durability		
Technological Durability		
Serviceability		
Aesthetics		
Product Image		
Company Image		
Customer Relations		
Employee Relations		
Value for Money		
Manufacturing Lead Time	15%	
Rate of Product Introduction		
Delivery Lead Time		10%
Internal Due Date Performance	16%	15%
External Due Date Performance		
Frequency of Delivery	17%	
Manufacturing Cost	13%	33%
Value Added		
Selling Price		
Product Running Cost		
Product Service Cost		
Product Warranty Cost		
Incoming Material Quality		3%
Output Product Quality		
New Product Introduction	7%	12%
Product Modification	7%	
Delivery Flexibility		9%
Volume Flexibility		
Product Mix Flexibility		
Resource Mix Flexibility	5%	8%

Factors Identified as Externally Important by the Managers of Company A
Taking their Definitions into Account

Consistency Ratio:	11%	4%
Date:	16/1/91	17/1/91
	Marketing	Manufacturing
	Director	Director
Product Performance	41%	22%
Product Features		
Product Reliability	5%	
Company Reliability		
Conformance	16%	
Technical Durability		
Technological Durability		
Serviceability		7%
Aesthetics		14%
Product Image		16%
Company Image	17%	
Customer Relations		
Employee Relations		
Value for Money		
Manufacturing Lead Time		
Rate of Product Introduction		7%
Delivery Lead Time		
Internal Due Date Performance		
External Due Date Performance	5%	6%
Frequency of Delivery		
Manufacturing Cost		
Value Added		
Selling Price	3%	14%
Product Running Cost		
Product Service Cost		
Product Warranty Cost		
Incoming Material Quality		
Output Product Quality		
New Product Introduction		14%
Product Modification		
Delivery Flexibility	6%	
Volume Flexibility	7%	
Product Mix Flexibility		
Resource Mix Flexibility		
Safety		

Factors Identified as Externally Important by the Managers of Company A
Taking their Definitions into Account

Consistency Ratio:	4%	14%
Date:	17/1/91	16/1/91
	Production	Head of
	Manager	Dept. 1
Product Performance	31%	25%
Product Features		
Product Reliability	16%	18%
Company Reliability		
Conformance		
Technical Durability		
Technological Durability		
Serviceability		
Aesthetics		
Product Image	5%	
Company Image		
Customer Relations		
Employee Relations		
Value for Money	16%	
Manufacturing Lead Time		
Rate of Product Introduction		
Delivery Lead Time		10%
Internal Due Date Performance		
External Due Date Performance	13%	13%
Frequency of Delivery	4%	
Manufacturing Cost		
Value Added		
Selling Price	12%	2%
Product Running Cost		
Product Service Cost		6%
Product Warranty Cost		
Incoming Material Quality		
Output Product Quality		
New Product Introduction		5%
Product Modification	5%	
Delivery Flexibility		
Volume Flexibility		
Product Mix Flexibility		
Resource Mix Flexibility		
Safety		22%

Factors Identified as Externally Important by the Managers of Company A
Taking their Definitions into Account

Consistency Ratio:	9%	14%
Date:	27/2/91	16/1/90
	Head of	Foreman 1
	Dept. 2	
Product Performance		36%
Product Features		
Product Reliability	23%	12%
Company Reliability		
Conformance		
Technical Durability		
Technological Durability		
Serviceability	17%	9%
Aesthetics	5%	2%
Product Image		23%
Company Image		
Customer Relations		
Employee Relations		
Value for Money		
Manufacturing Lead Time		
Rate of Product Introduction		
Delivery Lead Time		3%
Internal Due Date Performance		
External Due Date Performance	18%	6%
Frequency of Delivery		
Manufacturing Cost		
Value Added		
Selling Price	9%	10%
Product Running Cost		
Product Service Cost	12%	
Product Warranty Cost		
Incoming Material Quality		
Output Product Quality		
New Product Introduction		
Product Modification	8%	
Delivery Flexibility		
Volume Flexibility		
Product Mix Flexibility	7%	
Resource Mix Flexibility		
Safety		

Factors Identified as Externally Important by the Managers of Company A Taking their Definitions into Account

Consistency Ratio:	7%	
Date:	30/11/90	
	Foreman 2	
Product Performance		
Product Features		
Product Reliability	10%	
Company Reliability		
Conformance		
Technical Durability		
Technological Durability		
Serviceability	8%	
Aesthetics		
Product Image	12%	
Company Image		
Customer Relations		
Employee Relations		
Value for Money	17%	
Manufacturing Lead Time		
Rate of Product Introduction	11%	
Delivery Lead Time		
Internal Due Date Performance		
External Due Date Performance	13%	
Frequency of Delivery		
Manufacturing Cost		
Value Added		
Selling Price	18%	
Product Running Cost		
Product Service Cost	12%	
Product Warranty Cost		
Incoming Material Quality		
Output Product Quality		
New Product Introduction		
Product Modification		
Delivery Flexibility		
Volume Flexibility		
Product Mix Flexibility		
Resource Mix Flexibility		
Safety		

Factors Identified as Internally Important by the Management Trainees and Control in Company A

Consistency Ratio:		10%	8%
Date:		16/11/90	17/1/91
		Management	Management
		Trainee 1	Trainee 1
		Pre-marketing	Post-marketing
Performance	Q1		22%
Features	Q2		
Reliability	Q3		11%
Conformance	Q4		
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		3%
Perceived Quality	Q8		
Humanity	Q9		
Value	Q0		
Manufacturing Lead Time	T1	8%	12%
Rate of Product Introduction	T2		
Delivery Lead Time	T3		
Due Date Performance	T4	4%	5%
Frequency of Delivery	T5		
Manufacturing Cost	C1	28%	10%
Value Added	C2	24%	24%
Selling Price	C3		
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3	7%	14%
Modification	F4		
Deliverability	F5		
Volume	F6	15%	
Product Mix	F7	5%	
Resource Mix	F8	9%	

Factors Identified as Internally Important by the Management Trainees and Control in Company A

Consistency Ratio:		12%	16%
Date:		21/11/90	16/1/91
		Nov. 1990	Jan. 1991
Performance	Q1	4%	3%
Features	Q2		
Reliability	Q3		
Conformance	Q4		
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8		
Humanity	Q9		
Value	Q0	4%	21%
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2	9%	5%
Delivery Lead Time	T3	13%	8%
Due Date Performance	T4	12%	15%
Frequency of Delivery	T5		
Manufacturing Cost	C1	28%	29%
Value Added	C2		
Selling Price	C3		
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3	13%	9%
Modification	F4		
Deliverability	F5		
Volume	F6	17%	10%
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Internally Important by the Management Trainees and Control in Company A

Consistency Ratio:		6%	14%
Date:		25/3/91	27/2/91
		March 1991	Management
			Trainee 2
			Pre-marketing
Performance	Q1	5%	
Features	Q2		
Reliability	Q3		
Conformance	Q4		4%
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8		3%
Humanity	Q9		2%
Value	Q0	21%	
Manufacturing Lead Time	T1		18%
Rate of Product Introduction	T2	6%	
Delivery Lead Time	T3	7%	23%
Due Date Performance	T4	15%	8%
Frequency of Delivery	T5		
Manufacturing Cost	C1	37%	
Value Added	C2		34%
Selling Price	C3		
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3	6%	
Modification	F4		
Deliverability	F5		
Volume	F6	4%	
Product Mix	F7		9%
Resource Mix	F8		

Factors Identified as Internally Important by the Management Trainees and Control in Company A

Consistency Ratio:		11%	
Date:		25/3/91	
		Management	
		Trainee 2	
		Post-marketing	
Performance	Q1		
Features	Q2		
Reliability	Q3		
Conformance	Q4	8%	
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8	16%	
Humanity	Q9	5%	
Value	Q0		
Manufacturing Lead Time	T1	15%	
Rate of Product Introduction	T2		
Delivery Lead Time	T3	8%	
Due Date Performance	T4	10%	
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2	23%	
Selling Price	C3		
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3		
Modification	F4		
Deliverability	F5		
Volume	F6		
Product Mix	F7	16%	
Resource Mix	F8		

Factors Identified as Externally Important by the Management Trainees and Control in Company A

Consistency Ratio:		29%	7%
Date:		16/11/90	17/1/91
		Management Trainee 1 Pre-marketing	Management Trainee 1 Post-marketing
Performance	Q1	36%	25%
Features	Q2		
Reliability	Q3	14%	20%
Conformance	Q4		
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		8%
Perceived Quality	Q8		15%
Humanity	Q9		
Value	Q0	10%	
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2	6%	
Delivery Lead Time	T3	8%	10%
Due Date Performance	T4	8%	6%
Frequency of Delivery	T5	6%	
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3	11%	4%
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3		12%
Modification	F4		
Deliverability	F5		
Volume	F6		
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Externally Important by the Management Trainees and Control in Company A

Consistency Ratio:		12%	9%
Date:		21/11/90	16/1/91
		Nov. 1990	Jan. 1991
Performance	Q1	35%	36%
Features	Q2		
Reliability	Q3	8%	9%
Conformance	Q4		
Technical Durability	Q5	4%	4%
Serviceability	Q6	4%	5%
Aesthetics	Q7	20%	16%
Perceived Quality	Q8		
Humanity	Q9		
Value	Q0		
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3	6%	9%
Due Date Performance	T4	13%	14%
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3		
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3		
Modification	F4		
Deliverability	F5	9%	9%
Volume	F6		
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Externally Important by the Management Trainees and Control in Company A

Consistency Ratio:		9%	14%
Date:		25/3/91	27/2/91
		March 1991	Management
			Trainee 2
			Pre-marketing
Performance	Q1	36%	30%
Features	Q2		
Reliability	Q3	9%	
Conformance	Q4		
Technical Durability	Q5	4%	
Serviceability	Q6	5%	22%
Aesthetics	Q7	16%	7%
Perceived Quality	Q8		
Humanity	Q9		2%
Value	Q0		
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3	9%	
Due Date Performance	T4	14%	16%
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3		4%
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3		11%
Modification	F4		
Deliverability	F5	9%	7%
Volume	F6		
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Externally Important by the Management Trainees and Control in Company A

Consistency Ratio:		13%	
Date:		25/3/91	
		Management	
		Trainee 2	
		Post-marketing	
Performance	Q1	34%	
Features	Q2		
Reliability	Q3		
Conformance	Q4		
Technical Durability	Q5		
Serviceability	Q6	21%	
Aesthetics	Q7	7%	
Perceived Quality	Q8		
Humanity	Q9	2%	
Value	Q0		
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3		
Due Date Performance	T4	15%	
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3	4%	
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3	10%	
Modification	F4		
Deliverability	F5	7%	
Volume	F6		
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Internally Important by the Directors of Company B

Consistency Ratio:		12%	3%
Date:		22/1/91	28/2/91
		Electronics	Financial
		Design Director	Director
Performance	Q1	8%	9%
Features	Q2		
Reliability	Q3	9%	13%
Conformance	Q4	20%	20%
Technical Durability	Q5	6%	
Serviceability	Q6	4%	
Aesthetics	Q7		
Perceived Quality	Q8		26%
Humanity	Q9		
Value	Q0		
Manufacturing Lead Time	T1	5%	
Rate of Product Introduction	T2		
Delivery Lead Time	T3		
Due Date Performance	T4	22%	
Frequency of Delivery	T5		
Manufacturing Cost	C1	27%	
Value Added	C2		
Selling Price	C3		
Running Cost	C4		6%
Service Cost	C5		4%
Material Quality	F1		19%
Output Quality	F2		
New Product	F3		
Modification	F4		4%
Deliverability	F5		
Volume	F6		
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Internally Important by the Directors of Company B

Consistency Ratio:		16%	20%
Date:		28/2/91	1/5/91
		Managing	Manufacturing
		Director	Director
Performance	Q1	22%	
Features	Q2		
Reliability	Q3		8%
Conformance	Q4		
Technical Durability	Q5	5%	
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8	8%	5%
Humanity	Q9		
Value	Q0		7%
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3		
Due Date Performance	T4	11%	4%
Frequency of Delivery	T5		
Manufacturing Cost	C1	28%	26%
Value Added	C2		26%
Selling Price	C3	22%	23%
Running Cost	C4		
Service Cost	C5	4%	
Material Quality	F1		
Output Quality	F2		
New Product	F3		
Modification	F4	2%	
Deliverability	F5		
Volume	F6		
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Internally Important by the Directors of Company B

Consistency Ratio:		12%	
Date:		12/4/91	
		Mechanical	
		Design Director	
Performance	Q1	17%	
Features	Q2	5%	
Reliability	Q3	19%	
Conformance	Q4	10%	
Technical Durability	Q5		
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8		
Humanity	Q9		
Value	Q0		
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3		
Due Date Performance	T4	12%	
Frequency of Delivery	T5		
Manufacturing Cost	C1	26%	
Value Added	C2		
Selling Price	C3		
Running Cost	C4		
Service Cost	C5	8%	
Material Quality	F1		
Output Quality	F2		
New Product	F3		
Modification	F4	4%	
Deliverability	F5		
Volume	F6		
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Externally Important by the Directors of Company B

Consistency Ratio:		8%	2%
Date:		22/1/91	28/2/91
		Electronics Design Director	Financial Director
Performance	Q1		
Features	Q2		
Reliability	Q3	18%	
Conformance	Q4	25%	26%
Technical Durability	Q5	5%	
Serviceability	Q6	7%	14%
Aesthetics	Q7		5%
Perceived Quality	Q8		
Humanity	Q9		
Value	Q0		24%
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3	9%	
Due Date Performance	T4	23%	
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3	10%	
Running Cost	C4		12%
Service Cost	C5		10%
Material Quality	F1		
Output Quality	F2		
New Product	F3		
Modification	F4	3%	6%
Deliverability	F5		
Volume	F6		4%
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Externally Important by the Directors of Company B

Consistency Ratio:		9%	9%
Date:		28/2/91	22/3/91
		Managing	Manufacturing
		Director	Director
Performance	Q1	26%	26%
Features	Q2		
Reliability	Q3	8%	15%
Conformance	Q4		5%
Technical Durability	Q5		
Serviceability	Q6	2%	
Aesthetics	Q7		
Perceived Quality	Q8		
Humanity	Q9		3%
Value	Q0	20%	5%
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3		
Due Date Performance	T4	12%	7%
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2		31%
Selling Price	C3	23%	
Running Cost	C4	4%	
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3		
Modification	F4	4%	
Deliverability	F5		9%
Volume	F6		
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Externally Important by the Directors of Company B

Consistency Ratio:		4%	
Date:		12/4/91	
		Mechanical	
		Design Director	
Performance	Q1	22%	
Features	Q2		
Reliability	Q3	23%	
Conformance	Q4	20%	
Technical Durability	Q5	11%	
Serviceability	Q6		
Aesthetics	Q7		
Perceived Quality	Q8		
Humanity	Q9		
Value	Q0	7%	
Manufacturing Lead Time	T1		
Rate of Product Introduction	T2		
Delivery Lead Time	T3		
Due Date Performance	T4	11%	
Frequency of Delivery	T5		
Manufacturing Cost	C1		
Value Added	C2		
Selling Price	C3		
Running Cost	C4		
Service Cost	C5		
Material Quality	F1		
Output Quality	F2		
New Product	F3	4%	
Modification	F4	3%	
Deliverability	F5		
Volume	F6		
Product Mix	F7		
Resource Mix	F8		

Factors Identified as Internally Important by the Directors of Company B
Taking their Definitions into Account

Consistency Ratio:	12%	3%
Date:	22/1/91	28/2/91
	Electronics	Financial
	Design Director	Director
Product Performance	20%	9%
Product Features		
Product Reliability	9%	13%
Company Reliability		
Conformance	8%	20%
Technical Durability	6%	
Technological Durability		
Serviceability	4%	
Aesthetics		
Product Image		
Company Image		26%
Customer Relations		
Employee Relations		
Value for Money		
Manufacturing Lead Time		
Rate of Product Introduction		
Delivery Lead Time		
Internal Due Date Performance		
External Due Date Performance	22%	
Frequency of Delivery		
Manufacturing Cost	27%	
Value Added		19%
Selling Price		
Product Running Cost		6%
Product Service Cost		
Product Warranty Cost		4%
Incoming Material Quality		
Output Product Quality		
New Product Introduction		4%
Product Modification		
Delivery Flexibility	5%	
Volume Flexibility		
Product Mix Flexibility		
Resource Mix Flexibility		

Factors Identified as Internally Important by the Directors of Company B
Taking their Definitions into Account

Consistency Ratio:	16%	20%
Date:	28/2/91	1/5/91
	Managing	Manufacturing
	Director	Director
Product Performance	22%	
Product Features		
Product Reliability		8%
Company Reliability		
Conformance		
Technical Durability	5%	
Technological Durability		
Serviceability		
Aesthetics		
Product Image		5%
Company Image	8%	
Customer Relations		
Employee Relations		
Value for Money		7%
Manufacturing Lead Time		
Rate of Product Introduction		
Delivery Lead Time		4%
Internal Due Date Performance		
External Due Date Performance	11%	
Frequency of Delivery		
Manufacturing Cost	28%	26%
Value Added		26%
Selling Price	22%	23%
Product Running Cost		
Product Service Cost		
Product Warranty Cost	4%	
Incoming Material Quality		
Output Product Quality		
New Product Introduction		
Product Modification		
Delivery Flexibility		
Volume Flexibility		
Product Mix Flexibility		
Resource Mix Flexibility	2%	2%

Factors Identified as Internally Important by the Directors of Company B
Taking their Definitions into Account

Consistency Ratio:	12%	
Date:	12/4/91	
	Mechanical	
	Design Director	
Product Performance	17%	
Product Features	5%	
Product Reliability	19%	
Company Reliability		
Conformance	10%	
Technical Durability		
Technological Durability		
Serviceability		
Aesthetics		
Product Image		
Company Image		
Customer Relations		
Employee Relations		
Value for Money		
Manufacturing Lead Time		
Rate of Product Introduction	4%	
Delivery Lead Time		
Internal Due Date Performance		
External Due Date Performance	12%	
Frequency of Delivery		
Manufacturing Cost	26%	
Value Added		
Selling Price		
Product Running Cost		
Product Service Cost		
Product Warranty Cost	8%	
Incoming Material Quality		
Output Product Quality		
New Product Introduction		
Product Modification		
Delivery Flexibility		
Volume Flexibility		
Product Mix Flexibility		
Resource Mix Flexibility		

Factors Identified as Externally Important by the Directors of Company B
Taking their Definitions into Account

Consistency Ratio:	8%	2%
Date:	22/1/91	28/2/91
	Electronics	Financial
	Design Director	Director
Product Performance		
Product Features		
Product Reliability	18%	
Company Reliability		
Conformance	25%	26%
Technical Durability		
Technological Durability	5%	
Serviceability	7%	14%
Aesthetics		5%
Product Image		
Company Image		
Customer Relations		
Employee Relations		
Value for Money		24%
Manufacturing Lead Time		
Rate of Product Introduction		
Delivery Lead Time	9%	
Internal Due Date Performance		
External Due Date Performance	23%	
Frequency of Delivery		
Manufacturing Cost		
Value Added		
Selling Price	10%	
Product Running Cost		12%
Product Service Cost		10%
Product Warranty Cost		
Incoming Material Quality		
Output Product Quality		
New Product Introduction		
Product Modification	3%	6%
Delivery Flexibility		
Volume Flexibility		4%
Product Mix Flexibility		
Resource Mix Flexibility		

Factors Identified as Externally Important by the Directors of Company B
Taking their Definitions into Account

Consistency Ratio:	9%	9%
Date:	28/2/91	22/3/91
	Managing	Manufacturing
	Director	Director
Product Performance	26%	
Product Features		
Product Reliability		15%
Company Reliability		
Conformance		5%
Technical Durability	8%	26%
Technological Durability		
Serviceability	2%	9%
Aesthetics		3%
Product Image		
Company Image		
Customer Relations		
Employee Relations		
Value for Money	20%	5%
Manufacturing Lead Time		
Rate of Product Introduction		
Delivery Lead Time		
Internal Due Date Performance		
External Due Date Performance	12%	7%
Frequency of Delivery		
Manufacturing Cost		
Value Added		31%
Selling Price	23%	
Product Running Cost	4%	
Product Service Cost		
Product Warranty Cost		
Incoming Material Quality		
Output Product Quality	4%	
New Product Introduction		
Product Modification		
Delivery Flexibility		
Volume Flexibility		
Product Mix Flexibility		
Resource Mix Flexibility		

Factors Identified as Externally Important by the Directors of Company B
Taking their Definitions into Account

Consistency Ratio:	4%	
Date:	12/4/91	
	Mechanical	
	Design Director	
Product Performance	22%	
Product Features		
Product Reliability	23%	
Company Reliability		
Conformance	20%	
Technical Durability	11%	
Technological Durability		
Serviceability		
Aesthetics		
Product Image		
Company Image		
Customer Relations		
Employee Relations		
Value for Money	7%	
Manufacturing Lead Time		
Rate of Product Introduction		
Delivery Lead Time		
Internal Due Date Performance		
External Due Date Performance	11%	
Frequency of Delivery		
Manufacturing Cost		
Value Added		
Selling Price		
Product Running Cost		
Product Service Cost		
Product Warranty Cost		
Incoming Material Quality		
Output Product Quality		
New Product Introduction	4%	
Product Modification	3%	
Delivery Flexibility		
Volume Flexibility		
Product Mix Flexibility		
Resource Mix Flexibility		

APPENDIX IV

Data collected during the shadowing study

Introduction

This appendix contains a summary of the data collected during the shadowing study. It presents both the diary that the author kept during the course of the study and a copy of the completed check sheets.

Day 1: Production Manager - 10/6/91

Initially I talked to the production manager about the bonus systems used in company A, particularly those that applied to him. The production manager explained that he felt that the emphasis on cost had increased since the company had been subject to a management buy-out. He said that following the buy-out the manufacturing director had introduced an annual bonus system based on output and cost. Feedback on progress was provided on wall charts which were updated bimonthly and these showed the projected level of bonus payment, which varied from £1000 to £0. In the first year that the system was being operated, however, it became apparent by period two that, because of a lack of demand, nobody would be getting a bonus. And the production manager argued that this led to many people mentally abandoning the system in period two. (N.B. The production manager said that he felt that an annual bonus was too infrequent. I would agree with this, particularly if you can know by period two that you will not get your bonus. The other problem with a site-wide bonus is that people may not believe that they can affect the outcome. Why should I try hard? How can my single action affect the bonus?)

Next the production manager explained the operator's individual incentive scheme. He said this was based on their weekly output, calculated from the performance indices and standard times. He acknowledged that the individual incentive scheme emphasised productivity and agreed that this would not necessarily help achieve the company achieve its schedule.

Following this discussion the production manager suggested that we walk around the shop floor and had a look at where the various departments were with respect to the schedule. We went to the mechanical assembly shop where the head of department explained about the skills matrix he used. The matrix records the skills each operator possesses and everyone, as far as the schedule allows, is encouraged to learn others. Most operators are employed to do a particular job and are paid for the standard rate for it, but if they are needed on another job they will be moved and temporarily paid a higher rate if the job requires a higher level of skill.

The rest of the day is summarised on the check sheets. Basically we went to two meetings: health and safety and product plan progress.

Day 2: Foreman 2 - 11/6/91

When I arrived foreman 2 appeared to be pleased to have me shadowing him. I say this, because although he took great delight in walking around the shop floor first thing in the morning with me following obediently behind shouting "Good morning" to everyone we passed, he spent much of the remainder of the day sitting in his office. After we had walked around the shop foreman 2 and I sat down to complete the time and attendance records. To do this foreman 2 simply looks at what is on the screen and checks who has clocked in and who hasn't. This ensures that he knows how many men he has for that day. Although completing the time and attendance records should be a five minute job, it took foreman 2 about an hour and a half, primarily because I kept disturbing him and asking him questions.

At about 10.30am the head of department A came to ask foreman 2 something. I'm not sure if he ever found out what he wanted to know, instead he asked me what I was doing and we ended up talking about the company for two hours. Most of this discussion centred on how the manning levels were calculated. The production scheduler calculates the hours required to manufacture the jobs on the next week's schedule. Each department has an assigned percentage

Date: 10/6/91 **Manager:** Production Manager **Sheet:** 1 of 3

Time	Stimulus	Sent/Received	Factor	Media	Comments
8.30	Tour of factory. Consistent message where are we versus plan.	Sent by production manager to heads of department and foremen.	Internal and external delivery.	Face-to-face	You must work to schedule.
10.35-10.36	I can't do that job. The components are not here.	Received by production manager from a foreman A.		Face-to-face	I can't work to schedule.
	We must have 50 by the end of today.	Sent by production manager to foreman A.	Internal and external delivery.	Face-to-face	You must work to schedule.
10.40-10.43	When will the donor machines be available? They were due in at 4.00pm yesterday. We have to get on with stripping them. Everyone has an agreed plan to work to.	Sent by production manager to purchasing manager.	External delivery to company.	Phone	Plan - keep to plan.
	The machines are here now.	Received by production manager from purchasing manager.	External delivery to company.	Phone	

Date: 10/6/91 **Manager:** Production Manager **Sheet:** 2 of 3

Time	Stimulus	Sent/Received	Factor	Media	Comments
10.46-10.51	Tell foreman B the donor machines for stripping are on the wagon. Get him to strip them and then pass the components to foreman B.	Sent by production manager to head of department B.	Internal delivery.	Phone	
11.00-13.00	Health and safety meeting.		Safety.	Meeting	Safety is important.
	Reduce cost of proposals, e.g. we have been told that we have to replace all of our chairs. This will cost us £2700 and that is too much.	Received by all present at the meeting - sent by the manufacturing director.	Reduce cost.	Meeting	But other things are more important.
13.40-13.45	One of my operatives is using a new saw and we can't get the job timed for three to four weeks. Can we guarantee the operatives minimum bonus?	Received by production manager from head of department 2.	Cost, output, productivity.	Face-to-face	
	No.	Sent by production manager to head of department 2.	Cost.	Face-to-face	

Date: 10/6/91 **Manager:** Production Manager **Sheet:** 3 of 3

Time	Stimulus	Sent/Received	Factor	Media	Comments
14.15-14.30	We don't have any timber for our saw. We'll have to change the schedule.	Received by production manager from head of department 2.	Schedule.	Face-to-face	
	Yes do that. You have to use your standard hours.	Sent by production manager to head of department 2.	Utilisation.	Face-to-face	
15.00-16.15	Product plan progress meeting.		Due-dates, stock costs, new product introduction.	Meeting	Discussion of new product introduction plan.
16.15-17.00	Sub discussion of product plan.		Due-dates, stock costs, new product introduction.	Meeting	Discussion of new product introduction plan.

efficiency (department 2 is known, from past history, to operate at 81% efficiency, while department A operates at 98% efficiency). Hence the required hours are increased to allow for known efficiencies. A further allowance of 9% is added for absenteeism and set-up. Each head of department (or foreman, if the job is delegated) then decides what his manning requirements are. The total labour cost for each department is divided by the required hours to give a cost of labour per hour, which is compared with the budget and forecast figures.

The head of department A said that because he lost hours (i.e. hours were clocked on a blue or white cards and only hours clocked on a green card were recorded) and because he saved money (i.e. hours on a blue and white card were not paid at 100 PI) he found he could use overtime to increase the hours worked and hence use up the spare money he had from the forecast. He accepted that this would cost more than employing extra labour to work the normal thirty seven and a half hour week, but argued that because he could not ask for extra labour he only had the option of using overtime. I think I need to spend half a day with the people that calculate the hours and the costs because I am not sure (and neither was the head of department A) what figures were used where. For example, forecast hours were based on production scheduler's schedule plus the historical department efficiency plus the 9% allowance. Forecasts labour cost was based on this plus the type of labour required (skill level) and the spread of labour (shift premiums). Total hours actually worked were found on the green cards (productive time). Total actual cost was probably a combination of green, blue and white cards plus the performance indices. The end result of the system seemed to be that the head of department A did not work to schedule, he did not spend all the money allocated to him, he did not get all the productive hours he should have got, but that he was efficient in the work he did. (N.B. Actual efficiencies were calculated from the total actual hours, blue card divide by the cost).

During the course of the morning foreman 2 received various signals concerning the schedule, i.e. where are these jobs, what are you doing now, when is this going to be ready? Once the head of department A had gone I asked foreman 2 what other signals he received. The first one that he identified was an explanation of why he thought that some of the people I had already interviewed did not see quality as important. I showed foreman 2 a summary of the factors identified by all the production people and explained that I was interested in identifying what affected the different interviewees' profiles. Quality, or more precisely conformance to specification, came out as one area of discrepancy and foreman 2 suggested that maybe some people didn't see quality as important because they never got work returned to their department. I took this to mean that foreman 2 sometimes received quality related feedback in the form of rejects from other departments. Next foreman 2 explained the individual incentive scheme. When operators are producing a component and they have had the first off inspection done they clock onto a green card. They stay on a green card (one for each job) all the time they are doing productive work). At the end of a batch of work the operator clocks off the green card and writes in how many components he has produced during that period of time. The time taken to produce x components is compared with the work study standard and forms the basis for calculation of the operator's performance index (PI). The minimum is 75 PI and the maximum is 105 PI.

A couple of interesting points emerged during these discussions. First it appears that although the technical leading hands are responsible for allocating the jobs to the operators, the technical leading hand on the early shift tends to give out all the easy jobs and hence the afternoon shift gets all the difficult jobs, i.e. the ones that are difficult to complete in the standard time. Also the daily PI reports suggest that operators work hard at the beginning of the week (120 PI) and slow down on Friday (75 PI). Initially this was hearsay from both the head of department A and foreman 2, but I had a look at the job sheets for Friday and Thursday of last week. On every occasion when I found the same operator doing a job on both Thursday and Friday, I found that on Thursday the operator had a PI of approximately 120 but that on Friday it dropped to about 80. Bearing in mind that company A changes its schedule frequently and that work requirements can change between the beginning and end of the week, this drop off in performance may affect the ability of the company to stay on schedule. Furthermore, with the blue card system in operation it is relatively easy for an operator to work hard for three days and spend about two days clocked on to a blue card "labouring" which is paid at 90 PI.

Further information I collected on the payment system from the weekly pay report received by foreman 2 includes; 50% of people were on +/-2 PI of the 105 maximum. (17 people of 34). Of the 34 people in the department there were only 13 who were not earning a full bonus. (4 labour were earning a full bonus and 4 labour were not). Therefore of the 26 permanent employees in the department only 9 were not earning full bonus. Although I didn't note down this figure I have a feeling only 2 or 3 permanent members of staff were working at less than 103 PI. Hopefully I'll be able to get these figures tomorrow when I'm with the head of department 2.

Other forms of feedback/signals foreman 2 gets include; (a) departmental efficiencies reports, (b) time and attendance records, (c) performance index report. In addition the production manager frequently calls in to ask where the department is versus the schedule.

Day 3: Head of Department 2 - 912/6/91

I spent today with head of department 2. I got in at 8.30 and the head of department spent the first half hour on his computer working out a cutting list for his new wardrobe! We then went for a walk around the shop. Most of the signals head of department 2 received and sent were informal face-to-face messages. I tried to discuss the reports etc. he received but he said, "oh I just get the same ones as foreman 2". He did say that he got a quality report based on rejects found in final assembly on a monthly basis. We spent some time discussing the payment system. The head of department 2 said that he would scrap the old system and implement a plain piece-work system with no capping. I asked him whether he thought that a group based bonus system might be better but he said he had already implemented three plain piece-work systems as replacements for group based bonus systems. He argued that if group bonuses are introduced instead of slow workers speeding up to the rate of the fast workers, the fast workers slow down.

We also discussed his interviewee profile. The head of department 2 said that his profile was not really based on signals he received, but on common sense. He felt his answers were based on his view of how a company should operate. I am not sure what this means for the audit. Can I really examine signals that will influence the individual's perception?

The rest of the day is recorded on the check sheets. I spoke briefly to the production manager. He agreed that I could have access to past data on the payment system.

Day 4: Head of Department 1 - 13/6/91

I spent between 8.30am and 2.00pm with the head of department 1. Foreman 1 was also with us between 8.30am and 10.30am. I did not attempt to shadow head of department 1, primarily because nothing much was happening. Department 1 was due to run out of work by the afternoon which was why I left early. The other thing was that I'm not sure how much more I am going to get from shadowing people, although I'm going back tomorrow.

We spent the first hour discussing department 1 and how it operated. Because department 1 feeds parts to the rest of the factory the head of department is given a complete set of schedules. Hence he decides which components they need to make first. Department 1 uses the stores as a buffer. Every job from department 1 goes into store before being passed on to any other department. It tends to produce batches of 250 components. When a new schedule is raised the head of department 1 will talk with the production controllers and decide whether or not to load a new batch of components. For example, if they want 50 machines and there are 250 parts in buffer stocks he will probably not bother

Date: 12/6/91 **Manager:** Head of Department 2 **Sheet:** 1 of 5

Time	Stimulus	Sent/Received	Factor	Media	Comments
9.10-9.30	Walk through the shop. Various questions regarding the schedule.	Sent by head of department 2 to his subordinates.	Keep to schedule.	Face-to-face	
9.30-9.40	We've got a quality problem. All the holes on this board are 2mm too big The inspector thinks all the boards will have to be scrapped.	Received by head of department 2 from one of his technical leading hands.	Conform to specification.	Face-to-face	No attempt to solve the problem. The defects were caused by the operative using the wrong tool.
	The boards will be O.K.	Sent by the head of department 2 to one of his technical leading hands.	Conformance does not matter.	Face-to-face	
9.50	We've lost some components.	Technical leading hand to head of department 2.		Face-to-face	
	No we haven't. Here they are.	Head of department 2 to technical leading hand.		Face-to-face	
	This is 6mm perspex, not 5mm.	Technical leading hand to head of department 2.		Face-to-face	

Date: 12/6/91 **Manager:** Head of Department 2 **Sheet:** 2 of 5

Time	Stimulus	Sent/Received	Factor	Media	Comments
	We'll have to scrap these and start again.	Head of department 2 to technical leading hand.	Cost.	Face-to-face	Cost does not matter.
10.00-12.00	Health and safety meeting. General theme is safety and housekeeping.	Sent by production manager to all present.	Safety, housekeeping.	Meeting	
	Discussion of report from risk assessors. "Its a harsh report. We need to act on it to keep our insurance premiums down."	Sent by production manager to all present.	Cost.	Meeting	Poor housekeeping is a fire hazard.
	We're going to introduce a weekly audit. The personnel manager and I will tour the shop and score the safety and housekeeping in each department.	Sent by production manager to all present.	Safety, housekeeping.	Meeting	
	We've got to do this to show the risk assessors that we have a formal system.	Sent by personnel manager to all present.	Safety, housekeeping.	Meeting	Does safety matter? Or is it apparent safety that matters.

Date: 12/6/91 **Manager:** Head of Department 2 **Sheet:** 3 of 5

Time	Stimulus	Sent/Received	Factor	Media	Comments
12.00	We'll have to write a proposal. How much will the change cost?	Received by head of department 2 from work study engineer.	Cost.	Face-to-face	
12.05-12.10	This cabinet has been marked.	Received by head of department 2 from one of his technical leading hands.	Aesthetics.	Face-to-face	
	It won't matter.	Sent by head of department 2 to one of his technical leading hands.	Aesthetics.	Face-to-face	Product aesthetics is not important.
	Shall I get someone down to check?	Received by head of department 2 from one of his technical leading hands.	Aesthetics.	Face-to-face	Implicit suggestion is that the head of department is wrong.
	There's no need.	Sent by head of department 2 to one of his technical leading hands.	Aesthetics.	Face-to-face	

Date: 12/6/91 **Manager:** Head of Department 2 **Sheet:** 4 of 5

Time	Stimulus	Sent/Received	Factor	Media	Comments
12.10	How much are the clips? If they are cheap enough we are going to start using them instead of dowels and glue.	Sent by head of department 2 to one of his suppliers.	Cost.	Phone	
12.20	The production manager has told me to switch off one of the drilling machines because it has no guard.	Received by head of department 2 from his foreman.	Safety.	Face-to-face	The production manager is serious about safety.
	What about the Holzma saw (a bottleneck machine with no guard)?	Sent by head of department 2 to his foreman.	Utilisation.	Face-to-face	
	Oh - that is still running.	Received by head of department 2 from his foreman.	Utilisation.	Face-to-face	Adherence to schedule is more important than safety.
12.35	Mechanical assembly will want the components for the Dutch machines this afternoon.	Received by head of department 2 from one of his technical leading hands.		Face-to-face	

Date: 12/6/91 **Manager:** Head of Department 2 **Sheet:** 5 of 5

Time	Stimulus	Sent/Received	Factor	Media	Comments
	I've seen the full schedule. Final assembly don't need to start work on the Dutch until Friday, so it doesn't matter if mechanical assembly don't get them until tomorrow.	Sent by head of department 2 to one of his technical leading hands.	External delivery performance.	Face-to-face.	Don't ask me to change what I'm doing now. We'll have to waste time resetting the machine.

making the parts. This is only the case for commonly used parts. All others are made for the specific job. The way the head of department 1 schedules work is as follows. All parts not available from the stores are loaded first. Jobs for departments A and 2 take precedence over those for final assembly. Next all components where the buffer stocks are getting low are produced. These components are placed into stores and used to replenish the buffer stocks. Both the head of department 1 and foreman 1 argued that this was the most sensible way of operating because the use of buffer stocks provided a safety net.

Once foreman 1 had left I asked the head of department 1 about his interviewee profile and why he felt he had given me the answers he had. He said that he felt the most important thing was for the company to hit delivery targets and only then worry about costs. He then added that he felt that manufacturing director seemed to put the emphasis the other way around, i.e. cost followed by delivery schedule. This change is something that numerous interviewees felt had occurred site the management buy-out. We then spent some time discussing signalling systems in company A, particularly bonus systems. The head of department 1 explained that they used to have a secret bonus. Anyone at or above the head of department level was paid a bonus of £500 every six months if the factory sold the budgeted number of machines. In this system there was no emphasis on cost.

When asked about the performance measurement the head of department 1 said that he assessed his own performance against his peers. If either department's 2 or A were getting better figures then him he would worry, but because they were not then he felt he could afford to relax to a certain extent.

Day 5: Foreman 1 - 14/6/91

I did not spend long in company A today because it only operates for half a day on Friday and because I was not gaining much more from shadowing. I arrived at 8.15am and spent about an hour chatting to foreman 2. I showed him his interviewee profile and asked him to comment on it. As ever foreman 2 was a little hesitant and made one or two comments about the differences between his profile and the others, but they were of such a general nature that they were no use. Next we went to a meeting (video on blow moulding), but as nothing else was due to happen that day, I then made my excuses and left.

On reviewing the week I think it was quite useful but I am not sure where it has got me. As expected, the manager of company A appear to use goal setting, performance measurement, feedback and reward systems to influence people's behaviour. There seem to be some problems with communication between departments, particularly at head of department level. From the point of view of my research I need a chance to review the work. It appears to me that I started out by arguing that once a strategy had been selected then it was important that the employees understand the salient parts of this strategy (quality, time, cost and flexibility). Hence the first thing to do was to try and find out to what extent these characteristics were understood. In company A's case the interviews appear to suggest that there is an underlying level of congruence that I have not picked up. At least the systems company A operates and the actions people take suggest there is an underlying level of goal congruence due to the scheduling system used. The company appears to be schedule driven. Why then in the interviews did I not pick this up? I think it is mainly because I was using the generic terms (quality, time, cost and flexibility) whereas each company has its own "company language". In company A's case I think if I had asked everyone how important they thought the schedule was I am sure I would have got a consistent, or more consistent, answers. Why then was this not converted into importance of passing work from one department to another? Perhaps I have too many factors. What about interviews with the senior managers. From these and a group discussion I could begin to develop a picture of the firm's strategy. Once these interviews had been completed I could define those factors which were important in "company language" and then begin the individual interviews. Hence in company A's case if I had interviewed the directors I could have got a list of important factors. These could then be used as the basis for short interviews with other employees.

Firstly they could complete the pair-wise comparison, then they could tell me why they thought what they thought. Can this be converted to an audit? Yes; first pairwise comparison, results need to be output immediately... careful questionnaire design. Second look at ranking and ask questions. For example, what is the most important factor? Why do you think this? Or statements...my payment system emphasises this....

APPENDIX V

Data collected in companies C and D

Data Collected During the Structured Interviews In Company C

	Prioritisation Mission A	Prioritisation Mission B	Prioritisation Mission C
Managing Director	13%	53%	16%
Production Manager	32%	30%	14%
Supervisor 1	45%	32%	14%
Supervisor 2	52%	19%	20%
Supervisor 3	16%	43%	31%
Supervisor 4	12%	39%	8%
Operative 1	27%	39%	16%
Operative 2	13%	63%	8%
Operative 3	26%	40%	17%
Operative 4	6%	44%	24%
Operative 5	30%	33%	18%
Operative 7	16%	47%	24%
Operative 8	42%	11%	26%
Operative 9	28%	44%	16%
	Emphasis from systems Mission A	Emphasis from systems Mission B	Emphasis from systems Mission C
Supervisor 1	41%	27%	5%
Supervisor 2	34%	25%	11%
Supervisor 3	24%	19%	32%
Supervisor 4	23%	21%	22%
Operative 1	26%	26%	26%
Operative 2	15%	21%	30%
Operative 3	31%	26%	31%
Operative 4	15%	29%	30%
Operative 5	33%	28%	33%
Operative 7	20%	11%	7%
Operative 8	35%	7%	30%
Operative 9	40%	26%	21%

Data Collected During the Structured Interviews In Company C

	Prioritisation	Prioritisation	
	Mission D	Mission E	
Managing Director	7%	11%	
Production Manager	9%	14%	
Supervisor 1	3%	6%	
Supervisor 2	7%	3%	
Supervisor 3	4%	7%	
Supervisor 4	17%	25%	
Operative 1	14%	4%	
Operative 2	12%	5%	
Operative 3	6%	12%	
Operative 4	11%	15%	
Operative 5	13%	6%	
Operative 7	4%	9%	
Operative 8	14%	6%	
Operative 9	8%	3%	
	Emphasis	Emphasis	
	from systems	from systems	
	Mission D	Mission E	
Supervisor 1	14%	14%	
Supervisor 2	17%	13%	
Supervisor 3	16%	9%	
Supervisor 4	15%	18%	
Operative 1	11%	11%	
Operative 2	30%	5%	
Operative 3	12%	0%	
Operative 4	16%	9%	
Operative 5	7%	0%	
Operative 7	20%	43%	
Operative 8	3%	25%	
Operative 9	13%	0%	

Data Collected During the Management Group Discussion and Structured Interviews In Company D

	Prioritisation Mission A	Prioritisation Mission B	Prioritisation Mission C
Management Group	36%	22%	7%
Supervisor 1	18%	14%	11%
Supervisor 2	12%	34%	19%
Production Controller	23%	16%	5%
Materials Controller	8%	37%	5%
Operative 1	24%	17%	6%
Operative 2	36%	21%	4%
Operative 3	31%	24%	11%
Operative 4	23%	22%	7%
Operative 5	9%	13%	2%
Operative 6	24%	23%	8%
Operative 7	28%	21%	7%
	Emphasis from systems Mission A	Emphasis from systems Mission B	Emphasis from systems Mission C
Supervisor 1	20%	18%	16%
Supervisor 2	14%	28%	13%
Production Controller	18%	20%	17%
Materials Controller	3%	27%	9%
Operative 1	19%	19%	11%
Operative 2	17%	19%	15%
Operative 3	22%	19%	15%
Operative 4	31%	24%	11%
Operative 5	0%	36%	3%
Operative 6	15%	27%	12%
Operative 7	12%	26%	12%

Data Collected During the Management Group Discussion and Structured Interviews In Company D

	Prioritisation	Prioritisation	
	Mission D	Mission E	
Management Group	8%	8%	
Supervisor 1	5%	5%	
Supervisor 2	8%	4%	
Production Controller	11%	22%	
Materials Controller	2%	25%	
Operative 1	8%	17%	
Operative 2	15%	15%	
Operative 3	5%	15%	
Operative 4	10%	13%	
Operative 5	10%	29%	
Operative 6	8%	22%	
Operative 7	11%	16%	
	Emphasis	Emphasis	
	from systems	from systems	
	Mission D	Mission E	
Supervisor 1	7%	7%	
Supervisor 2	1%	11%	
Production Controller	4%	7%	
Materials Controller	0%	22%	
Operative 1	0%	11%	
Operative 2	11%	14%	
Operative 3	7%	15%	
Operative 4	2%	5%	
Operative 5	3%	18%	
Operative 6	1%	18%	
Operative 7	1%	9%	

Data Collected During the Management Group Discussion and Structured Interviews In Company D

	Prioritisation	Prioritisation	
	Mission F	Mission G	
Management Group	13%	6%	
Supervisor 1	5%	41%	
Supervisor 2	2%	21%	
Production Controller	19%	4%	
Materials Controller	13%	9%	
Operative 1	12%	17%	
Operative 2	5%	5%	
Operative 3	4%	10%	
Operative 4	12%	13%	
Operative 5	21%	16%	
Operative 6	7%	7%	
Operative 7	10%	6%	
	Emphasis	Emphasis	
	from systems	from systems	
	Mission F	Mission G	
Supervisor 1	16%	17%	
Supervisor 2	6%	27%	
Production Controller	19%	15%	
Materials Controller	23%	16%	
Operative 1	19%	21%	
Operative 2	10%	14%	
Operative 3	11%	11%	
Operative 4	15%	11%	
Operative 5	31%	10%	
Operative 6	18%	9%	
Operative 7	17%	24%	