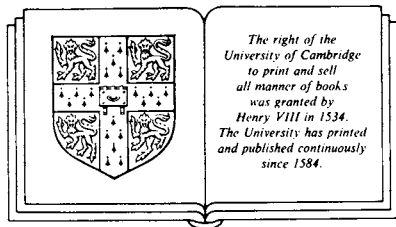


Managing innovation: A study of British and Japanese factories

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1

British factories, Japanese factories and the new technology debate

1.1 Introduction

This book sets out to answer a limited number of questions but covers a wide range of enquiry, from personnel practices and industrial relations to factory automation, training and work organization. It aims to provide a perspective on how process innovation is approached and new technology used in British and Japanese factories, and how these are related to employment relations. The basic questions asked are these: Why should the same technology introduced into manufacturing organizations invite friction in some cases and cooperation in others, or lead to 'deskilling' in some cases and 'reskilling' in others? What practices, attitudes and institutions lie behind these differences?

The book focusses on a particular application of microelectronics technology – computerized machine tools. Machine tools cut, drill, bore, grind or shape metal with various tools. Conventionally their movements are controlled by levers and handles manipulated by an operator, but numerical control (NC) machine tools are manipulated by a predetermined code or programme initiated via an electronic control system. Computer numerical control (CNC), as the name suggests, adds to this a reprogrammable computerized controller.¹ If machine tools, which cut, grind or shape metal are the 'guts' of modern industry, as Noble (1984) says, NC and CNC have been the 'guts' of much of the debate and occasional research into the usage of new technology.

Much of this was sparked by Braverman, who, in an influential book, *Labor and Monopoly Capital* (1974), argued that new technology in general and numerical control in particular allows capitalists to gain control over the work process from recalcitrant craftsmen and 'deskill' them and their jobs. It does this by separating the conceptual part of the work, which becomes programming, from execution, which becomes machine minding. Tapes can be prepared in an office by workers amenable to managerial

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control, allowing managers to replace the craftsmen on the shop-floor with unskilled workers and more machines. This possibility is seized upon by capitalists and their agents with the 'inevitability that devastates with the force of a natural calamity' (Braverman, 1974, 194) as it removes the final obstacle to the capitalists' quest for control and the freedom to pursue surplus value in the face of mounting competition.

Other writers have pointed out that there are alternative ways to extract surplus value or pursue profits, and that new technology such as computerized machine tools may be used for these ends. Attempting to reduce delivery times to gain new orders is one example. While increased control and 'deskilling' may indeed represent one management strategy, this may reach the point of diminishing returns, for labour can never be completely commodified and capitalists need not only to control workers, but need their consent as well (Littler and Salaman, 1984). This is especially so where flexibility in work practices is needed to utilize new technology most efficiently. Different management strategies, based on human relations or neo-human relations theories seeking to enlist worker cooperation, may lead to 'reskilling' and job enlargement. Operators may be given the job of programming, which has become more feasible with recent CNC technology.

Whether managers pursue coherent 'strategies' or not is of course open to question. Even if they do, strategies are shaped by existing structures (Batstone *et al.*, 1987), and one strategy might be pursued in industrial relations and another in work processes (Rose and Jones, 1985). One further perspective is that computerized machine tool use is not the result of capitalists' preoccupation with deskilling or managerial strategies at all, but of such factors as factory size and the size of the batches that the factory turns out. Large factories and large batches lead to a bureaucratic division of labour and a polarization of skills. Beyond these, differences from one factory to another are related mainly to production organization and approaches to training (Sorge *et al.*, 1983).

To shed light on this debate, this book looks at computerized machine tool use in Japanese factories, famous for their cooperative industrial relations, and in British factories, famous for a more abrasive style of industrial relations. Industrial relations do not simply reflect managerial strategies; in Japan they are said to be upheld by the 'three pillars' of lifetime employment, *nenko* (seniority plus merit) wages and promotion, and enterprise unionism. The linkages between these often institutionalized aspects of employment relations (employment, payment and industrial relations systems) and computerized machine tool use are therefore explored.

Of course not all Japanese factories are characterized by one type of employment relation and all British factories by another. Two ideal types

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are constructed; organization-oriented employment relations (OER) and market-oriented employment relations (MER). The terms and basic concepts originate from Dore (1973), and are in effect a formalized and extreme epitomization of what are often spoken of as typical Japanese and British employment relations respectively. OER and MER are poles of a continuum along which the employment relations of different factories may be located. These locations may be compared with certain aspects of CNC use, particularly the training of operators and the organization of operators' tasks, to find out whether or not there are any systematic differences related to employment relations.

This approach should prove more sensitive to both cross-national as well as intra-national differences than blanket typologies like that of Littler (1982), which describes Taylorism as the predominant management strategy in British factories, characterized by a dynamic of deskilling and task control, as opposed to *shudanshugi* (groupism)² in Japanese factories, which leads to the development of generalized, semi-skilled workers. (This approach has the additional weakness of placing too much emphasis on management strategies.) First, the continuum itself is more sensitive than are discrete typologies, and secondly, it does not assume that all British companies are located at one end and all Japanese companies at the other.

Four hypotheses are given; that the closer a factory to the organization-oriented (OER) pole of employment relations, the more training is given to CNC operators; that the closer a factory to the OER pole, the wider their task range; that the influence of factory size and batch size is mediated by employment relations; and that the closer a factory to the OER pole, the higher the skill levels of CNC operators.³

In the course of testing these hypotheses a number of related, topical issues are discussed. Many of these relate to innovation, both technological and otherwise. British (and American) managers are often criticized for their shortcomings regarding innovation – their apparent failure to take it seriously or reflect it in integrated, long-term strategies. This results in wasted potential, unnecessary friction and sometimes outright failure.⁴

The implicit or explicit exemplary approach held up is frequently that of Japanese firms. Not only are Japanese companies good at commercializing new technologies, as can be seen with computerized machine tools, but they seem to be extremely good at using them, too. Japanese managers are supposedly convinced of the strategic value of new technologies, are able to take a long-term view in corporate planning free from the tyranny of accountants, invest in training their 'human resources' rather than treating them as costs, and so on.

Not only are Japanese managers credited with having a more 'holistic' view of innovation – linking separate microelectronics applications to

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achieve systems gains (Kaplinsky, 1984) and linking the introduction of new technology to non-technical factors at the planning stage – but they seem to have a more holistic view of the innovation process itself, which they have acquired in the course of post-war reconstruction, in their drive to catch up with the west, and in surviving intense domestic competition. The objectives of introducing new technology – reducing operating costs, improving efficiency, increasing flexibility, raising the consistency and quality of products and improving control over operational processes according to Child (1984) – coincide with those of another form of process innovation developed in Japan and seen by some as being as revolutionary as Taylor's scientific management; just-in-time (JIT) production. The refinement of just-in-time, and one might add quality control activities, often go hand in hand with the introduction of new technology according to Abegglen and Stalk (1985).

These developments are aided by flexible employment practices which stress affiliation to the company rather than to a particular job, and payment and industrial relations practices which also tend to promote the flexibility that microelectronics, blending as it does traditional organizational and job boundaries, is seen to require.⁵ Job rotation and career ladders translate potential for flexibility into actuality. These practices are themselves innovations, starting before World War II but taking their present shape in the post-war period.

Some of the accounts of the Japanese 'model' are probably more prescriptive than descriptive, a projection of what would cure our industrial woes independent of their existence – or otherwise – in Japan. Furthermore, what may be true for Toyota or Nissan, Fanuc or Yamazaki, may not hold for other Japanese firms. A careful study of employment relations and computerized machine tool use in a variety of British and Japanese factories should aid our understanding of the 'innovative firm', the 'flexible firm', 'harmonization' and indeed 'Japanization', which provokes sharp reactions but is increasingly talked about.⁶

Nine factories in both countries, matched as closely as possible by size, technology and product, have been selected. While no claim to complete representativeness can be made, they provide a broad picture of the respective mechanical engineering industries which does not focus solely on technology leaders and large, famous firms, as is the case in so many studies of Japanese industry.

The findings point to significant differences both within and between the countries, some of which are surprising in view of conventional wisdom or popular accounts. British operators by and large were given *more* training for CNC than their Japanese counterparts, although their task ranges were

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not as extensive. This is linked to a different approach to computerized machine tools in both countries which has significant implications for innovation; a ‘technical’ approach in many of the Japanese factories, and a ‘craft’ approach in many of the British ones. In the former, for example, unmanned operation was an attraction of CNC, while in the latter a skilled craftsman had to be by the machine to get the most out of it. These approaches were influenced by employment relations, but in a more subtle way than at first suggested.

In the remainder of this chapter the reasoning behind the hypotheses mentioned above and the concepts they draw upon will be outlined, and a brief introduction to the 18 factories given. Chapter 2 provides an overview of the context of employment relations in Britain and Japan, which will help to put the individual factories in perspective. Chapters 3 and 4 describe employment relations in the 18 factories, while chapter 5 describes the introduction of CNC and other aspects of process innovation. Chapter 6 relates the training of workers operating the CNC machines, and chapter 7 the division of tasks around them. The various strands of these chapters are brought together and summarized in chapter 8, and the implications discussed. Hopefully the book will provide a modest contribution to the issues raised above, and to cross-national industrial research and understanding in general.

1.2 Employment relations

What are employment relations?

If the Japanese take a more holistic approach to innovation and corporate activities, as some have suggested, perhaps they do to industrial relations as well. The ‘three pillars’ or ‘three sacred treasures’ of lifetime employment, *nenko* (seniority plus merit) wages and promotion, and enterprise unions are the eternal theme of industrial relations discussions in Japan, according to an Economic Planning Agency (1986) book.⁷ It is rare to include all of this subject matter – employment practices, for example, and certain aspects of wages and promotion – in discussions of industrial relations in Britain, despite talk about industrial relations ‘systems’. In Japan, however, the three are considered to be intimately connected, and all must be considered when speaking of an industrial relations system.

The argument runs something like this: long-term employment, desirable from the company point of view to train and keep human resources, makes it possible and desirable – and is facilitated by – the rewarding of employees over a long time period, hence *nenko* wages and promotion. Workers within such companies find that their interests match closely those of others in the

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same company, hence they tend to organize within the organization itself – enterprise unions – which in turn promotes internal careers, and so on. The respective pillars are an integral part of the ‘system’.

This ‘system’ I have called ‘employment relations’. It includes employment, payment/reward and industrial relations. A further aspect which is seldom discussed under the rubric of industrial relations is ownership. Ownership may be considered an integral part of employment relations, or an (external) influence on them. Here the latter approach is taken, but this is one area in which more work needs to be done by industrial relations and related specialists.

Organization orientation and market orientation

One cannot assume that the three pillars are equally characteristic of all Japanese companies, or that individualistic, job-based contractualism based on external labour markets, which ‘Japanese-style management’ and the three pillars are often contrasted with, are equally characteristic of all western or British companies. Here I will propose two ideal, polar types of employment relations, the continuum between which different firms may be located; *organization-oriented employment relations* (OER) and *market-oriented employment relations* (MER). As with the three pillars, there are pressures towards inner consistency in the various sub-dimensions of these which would tend to locate companies towards these respective poles, but there are also other forces – economic and social – which act on the various sub-dimensions differentially and in divergent directions. Moreover, different groups of workers within the same company may be treated differently, such as full timers and part timers, or manual workers and non-manual workers. The focus in this book is on manual workers and the shop-floor, where interfirm differences in employment relations are likely to be most obvious. The concepts are summarized in table 1.1.

In OER employment, relative to that of MER, there would be:
more rigorous selection of employees because of the expectation of long-term employment;
more induction training for the same reason;
greater discrimination against mid-term entry and a younger average entry age;
the employment of workers for a career within the company not tied to a specific job.

In OER payment, relative to that of MER, there would be:
limited reference to market rates of pay, and fixed, organization-wide rules regarding pay raises and relativities;

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Table 1.1 *Organization-oriented employment relations (OER) and market-oriented employment relations (MER)*

OER	MER
<i>Employment</i> Recruitment of workers to become members of an organization, with entry from the bottom and internal progression.	<i>Employment</i> Recruitment of workers to perform specific jobs. Entry at any point.
<i>Payment</i> Based on attributes and performance relative to the members of the organization. 'Market' references limited to starting rates and average rises.	<i>Payment</i> 'Market' rate as references for jobs or persons doing jobs. Job or skill relativities within the firm.
<i>Industrial relations</i> Contoured to the organization according to organizational wages and internal career progression.	<i>Industrial relations</i> Contoured along skill or occupational lines according to skills being bought and sold, and external labour markets.

greater flexibility in moving workers between jobs without reference to pay;
 recognition and evaluation of the contribution of the individual towards organizational goals beyond narrowly defined production-related performance;
 greater reflection of company performance in payment, since all are assumed to be 'in the same boat';
 greater harmonization of employment conditions for all regular members of the company.

Regarding industrial relations, with OER relative to MER there would be:

- extensive use of joint consultation and other communications channels to foster 'organization consciousness';
- a focus of industrial relations and personnel management at the same level as business and corporate planning functions, the former being an integral part of the latter;
- limits of principal worker organization coinciding with those of the employing organization;
- a greater sense of 'common destiny' between managers and workers, with a blurred dividing line promoting this.

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The MER pole represents the archetypal contractual relationship with minimal overlap of interests beyond immediate economic ones. There is a clear dividing line between those selling their skills and those buying them, and compliance, in Etzioni's terms, is gained through remuneration and sometimes coercion. Attempts at normative compliance will be greeted by scepticism as being irrelevant to the basic nature of the relationship. There is an 'Us-Them' relationship between those selling their skills and those buying them.

The OER pole, on the other hand, represents a relationship with a social as well as an economic dimension (a more 'diffuse' relationship in Parsons' terms). The relative unimportance of specific job-related pay and the norm of upward mobility blurs the employment contract line, and the preferred means of gaining compliance is through normative integration. There *is* a coercive element in the relationship, because if a worker is not cooperative, his⁸ long-term pay and promotion prospects will suffer, but the coercive element is muted because (1) too much reliance on overt coercion is seen by managers as detrimental to the attainment of organizational goals they have established, and (2) the future of the individual becomes progressively more tied up with that of the organization, anyway. The 'Them' is externalized to those in competitor firms.

If 'Us' is to apply to most or all members of an organization, managers must be seen to be acting in the same interests as the workers (or at least convince workers that their interests coincide), and not as agents of parties on the other side of a market relationship. The power of outside shareholders to influence organizational goals and activities in their favour, therefore, is less in OER than MER, which implies a different *de facto* if not *de jure* relationship among shareholders, managers and employees. The MER firm belongs to its members – those who provide the capital and purchase the labour or labour power of the workers – while the OER firm 'belongs' to a significant extent to those who work in it, who are *its* members.

The ideal-typical constructions OER and MER also have something in common with formulations such as McGregor's (1960) Theory X and Theory Y, and other categorizations of managerial beliefs or strategies – Littler's has already been mentioned – but they involve often institutionalized relations which are not only created by these beliefs and strategies, but which also help to create them. There are some similarities with Williamson's (1975) Markets and Hierarchies modes of contracting, but while the employment relation *is* the hierarchy, and distinct from a contractual market relation for Williamson, here MER refers to a contractual form of employment relation. Since Williamson does acknowledge different degrees in interfirm market relations, presumably his framework would also allow for different degrees of hierarchy. In both

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conceptions the hierarchy or organization orientation is associated with a higher degree of cooperation with more scope for sequential decision making, while the problems of opportunism more frequently arise in the market mode or orientation.⁹

Fox (1974, 71–4) also has cogently described the link between relationships which are fundamentally contractual in nature (MER here) and spirals of mistrust.¹⁰ The minimal overlap of interests and the dichotomous buying/selling relationship gives rise to these, as both sides seek to maximize their returns. The institutions of OER, however, encourage competition against an outside ‘Them’ to enlarge ‘the pie’ rather than disputing the division of it with an internal ‘Them’ (with little penalty in the latter for seeking out another pie to divide if necessary). The employment, pay and industrial relations of MER referred to here would correspond quite well with Fox’s ‘institutionalized mistrust’ which he mentions but does not elaborate on, and OER to ‘institutionalized trust’.

There are two respects, then, in which the influence of employment relations on the use of new technology should be discussed; the first in the context of practices logically deriving from the employment relations themselves, and the second in the context of practices brought about by the differing degrees of cooperation and conflict the employment relations engender.

Britain and Japan

While no company is likely to have either pure market-oriented or pure organization-oriented employment relations, there is reason to expect that more Japanese companies will be towards the OER end of the spectrum, and more British companies towards the MER end, even though non-manual workers may be employed under OER or semi-OER in the latter.

Dore’s (1973) study of Hitachi and English Electric (two factories each), from which the terms ‘organization orientation’ and ‘market orientation’ derive, points in the same direction. Many of the features of the respective orientations are related to the period in which industrialization started, according to Dore; the ‘late development effect’. Industrialization started out with small firms in the earliest industrializer – Britain – which, coupled with the market philosophy, shaped labour market and industrial relations practices. While there was a small firm sector started by indigenous entrepreneurs in an open type of labour market (or family-oriented or paternalistic) in the later developer Japan, there was also an early large firm sector which was important in the development of labour market and industrial relations practices.

Large firms represented significant capital investment, and govern-

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mental concern and influence was strong. They were big enough to develop internal career structures, as in government employment, their stability enabled them to guarantee employment to their employees, and more effort was made in developing communication channels. Coupled with this in Japan was the desire to avoid the worst conflict associated with contractual relations in the earlier developers. These differences in starting points were important because 'organizations tend to preserve features characteristic of society at large at the time of their foundation' (Dore, 1973, 138).

Dore's theory would predict a variety of employment relations in Japan, especially between large and small firms, and some movement towards organization orientation in Britain, although not necessarily even or unidirectional. Of course the development of employment relations in both countries cannot be divorced from the specific historical and sociocultural contexts independent of social actors. Certain aspects of craft organization in Britain, for example, precede industrialization and factories, while employment relations in Japanese industry were markedly more market-oriented at the beginning of this century than they are today. World War II and its tumultuous aftermath were very important in the shift to organization orientation. These developments and employment relations in both countries will be discussed further in chapter 2.

1.3 Employment relations, computerized machine tools (CNC) and skills: four hypotheses

Below are four hypotheses concerning the relation between employment relations on the one hand, and computerized machine tools (CNC) and skills on the other. They are based on a sizeable literature, and each hypothesis is followed by a brief summary of supporting arguments.

Hypothesis 1 concerns training, which is related to operator skills, while Hypothesis 2 concerns task ranges, which are related to skills a job requires. Hypothesis 3 concerns the relative influence of employment relations and factors such as factory and batch size on CNC use; are employment relations a major or a minor influence? Finally, although skills are discussed in the first two hypotheses, these are combined in Hypothesis 4 to facilitate a general and summary discussion.

Hypothesis 1: More training is given to CNC operators where employment relations are organization-oriented than where they are market-oriented.

Training can refer to a number of things. With respect to CNC operators, it can be broadly divided into two different categories; training over time in various jobs, which forms the basis of machining skills but is not specifically

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directed at operating a certain CNC machine, and training specifically for CNC operating.

Where internal careers predominate (OER), one might expect these two types to merge, and for CNC operating to be slotted into a hierarchy of jobs of increasing difficulty and responsibility, as in figure 1.1. Many of the skills necessary for CNC operating, in this case, will be imparted on the daily job.

On the other hand, if an individual is employed for a specific job which is not necessarily seen as preparation for the next job in a progression (MER), more training may have to be given at the changing of jobs, possibly outside the company. If the onus is on the individual to compete to get a new job, more of this specific training will be done at his or her initiative.

Training might also be organized into one extended period, such as an apprenticeship, in which apprentices would forfeit higher immediate wages for higher eventual returns. In either case, workers may actually receive more training, since it is less streamlined for specific jobs required.

On the other hand, broader job experience may be given in OER to promote flexibility and greater understanding of the relationship of different jobs in the work process, as Koike argues is the case in Japan (1977, 1981b), and human capital theory would predict that where managers are afraid of losing workers to external markets (MER) they will be reluctant to provide training – at least at their expense.¹¹

In a contractual relationship where payment is made in principle for the job(s) done or the ability to do a certain job or jobs, someone with higher training would presumably try to extract the maximum price for his/her skills, while from the company side labour costs would be minimized by employing the minimum combination of skills necessary to get jobs done. *In theory*, then, equilibrium would coincide with minimum possible skill deployment, which implies minimum possible training.

OER payment, however, does not depend on the particular job being done. Labour costs might be minimized by using younger employees, but if it is not easy to make employees redundant given the norm of long-term employment, older, experienced workers would end up performing simpler tasks elsewhere (which would be against the norm of increasing responsibility). In this situation the career progression approach would be the most logical, and there would not be the same pressure to employ the minimum amount of skills necessary.

Furthermore, there is always bound to be a certain amount of bounded rationality involved in judging the amount of training necessary for new tasks. Managers would tend to choose the higher end of the scale who were (1) particularly concerned with quality, which is not necessarily related to employment relations, or (2) particularly concerned with morale, which *is* related to employment relations, particularly, as was argued, to OER.

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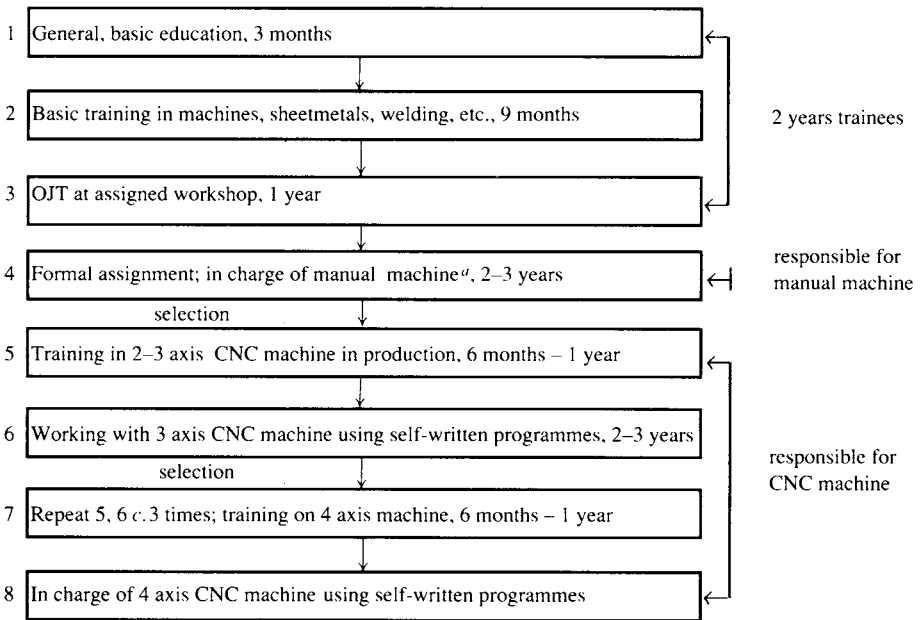


Figure 1.1 Career training for CNC operators in a Japanese factory

^aManual machine refers to a manually controlled or conventional machine tool.

Source: Tsusansho ed., 1984, 161

Finally, as Francis (1986) noted when discussing the deskilling debate, there are ways other than classical exploitation of labour and deskilling workers to achieve profitability – such as increasing market share, etc. In an OER situation, attempts to introduce new technology to supplant workers and skills (as opposed to augmenting these, or for handling ‘dirty’ work) would undermine the preferred method of gaining compliance – normative – hence would be avoided where possible. Of course introducing new technology in such a way would arouse fears if not outright opposition where remuneration is the main means of gaining compliance, and in keeping with this control mechanism, it might have to be sold to workers to ensure smooth introduction in the form of premiums. Using Fox’s terminology, however, it seems likely that the avoidance of low-trust initiatives will be higher on the list of OER managers’ priorities than those in MER. If control may become an end in itself on the one hand (see Noble’s account of the introduction of NC at GE’s Lynn factory; Noble, 1984), avoidance of low-trust initiatives and delegation of responsibility may be an important consideration on the other.¹²