INNOVATION AND THE ORGANISATION OF TECHNICAL EXPERTISE AND WORK
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Abstract
This paper reviews a selection of the comparative research on the organisation of skills and work in different countries. It argues that despite differences in institutional means, such as keiretsu and structured apprenticeship, the ends, in terms of a capacity to organise skills, is similar. It is suggested that the British institution of craft control of skills should be understood as the default state of organisation of skills and work. This state may be likely to develop anywhere where there is an absence of coercive control over the free rider effect. It is argued that the free rider effect is likely to have worse effect than is usually assumed in the case of the diffusion of innovative new technologies. The benefits of coercive arrangements to suppress free rider effects on skills should include the prevention of the development of craft control of work. The paper ends with a discussion of what makes an effective technology manager. The conclusion is that in the most effective cases, whatever the institutional means that allows training, the object is the integration of formal academic knowledge with a structured and broad base of work experience.
Much popular and guru-management writing is built around the claim to possess knowledge of best practice and in addition assumes that this knowledge can be passed on through written text to the reader. The empirical evidence that a practice is ‘best’ is often no more than the coincidence between a firm’s good financial performance and its possession of unusual practice. Nevertheless, this kind of analysis may be all that is possible when information is limited – as it was in the years of emerging awareness that Japanese quality practices were distinctive.

So this paper begins by taking the process by which one set of techniques become established as superior to another as interesting in its own right. In two major examples, of Japanese quality management techniques and Anglo-German matched manufacturing plants, this leads into the analysis of the organisational and institutional context that supports the generation and sustenance of such techniques. In these examples, institutions of apprenticeship and industrial organisation prove also to have an important bearing on the possibility of transfer of techniques between countries. The argument is that in their absence, or where, as in Great Britain, they have suffered decay, the ability of management to control work is weakened and so the ability to implement and adapt new technologies is weakened.

By demonstrating the importance for technology transfer of institutions of apprenticeship and industrial organisation, this paper justifies the analysis of the origin and reform of such institutions, a matter that inevitably involves the state.

Explaining Spectacular achievements in Japanese car production

*Development in the explanatory power of accounts of the Japanese achievement of quality and productivity leadership in car manufacture - JIT/TQM and ‘lean design’*

As Japanese firms gained US and European car market share from the 1960s – to reach over 30% of the US market (Womack, Jones and Roos 1990) - so did the necessity of finding an acceptable explanation of that success on the part of western observers. A kind of market in explanations developed with an excess of suppliers, so that Schonberger, the writer who did much to diffuse the notion of ‘Just in Time’ (JIT) manufacture as a bundle of freely transferable shop floor techniques could write ‘much of what is professed in current readings consists of half-truths and
misconceptions that stand in the way of rapid progress in catching up with the Japanese’ (Schonberger 1982,pvii). Schonberger made only passing reference to the role of Japanese industrial organisation: in contrast, Monden’s account of the development of the Toyota Production System for shop floor management not only described Toyota’s pioneering ingenuity in generating an evolving set of techniques, but allowed that this ability depended on differences in industrial organisation and social structure (Monden 1983).

Four years after Monden and five after Schonberger, the authors Clark, Chew and Fujimoto published research that suggested that nearly half of the leading Japanese car manufacturers’ advantage in quality and productivity derived from their management of the new model design process (Clark, Chew and Fujimoto 1987). So in retrospect both Monden and Schonberger were misleading by omission. That was understandable, because their method had been personal observation of highly visible shop floor practice, supplemented by published accounts and, in retrospect, very clearly limited company access.

By 1990 a popularising book ‘The Machine that Changed the World’ by Womack et al.,2 usefully combined descriptions of the shop floor and new model design techniques with comparative quality and productivity data for global car manufacturers (Womack, Jones and Roos 1990). These tended to show European car manufacturers at the bottom of the quality and productivity league tables. Womack et al. did not hesitate to make dire warnings of the consequences for European manufacturers if they failed to adopt these bundles of best practice techniques. Yet ten years after that book was published the dire consequences have not materialised for most European manufacturers, despite the Japanese retaining a lead in product quality and productivity. A reasonable speculation would be that the aesthetic appeal of certain new European models – Peugeot-Citroen’s range, or BMW’s new Mini - had begun to significantly offset the persistent advantage in productivity, quality and price of rival models that remained aesthetically dull.

Aesthetic advantage need not mean beauty. By the end of the 1990s US car manufacturer profitability had been temporarily-restored by the rise in

2 The book sold 400 000 copies in 11 languages, see:
www.leanuk.org/daniel_jon#25B6D
popularity of the gas-guzzling, monstrously heavy SUV (Sports Utility Vehicle) and the misleadingly named ‘light’ pickup trucks that together now account for more than half of all US new-vehicle sales (Easterbrook 2003,p27). Easterbrook cites survey evidence that such vehicles are bought for the – bogus – psychological sense of safety that they convey to their users.

When reviewing the history of popular management and economic analysis of the car industry it is difficult to avoid the conclusion that even when it has access to good data, at best it represents what has already happened and rarely does it predict future competitive circumstances well. Sometimes it merely sensationalises: in 1994 a best seller was titled ‘Comeback’, in reference to the apparent success of the Big Three US producers in fighting off the Japanese challenge. Now comes Maynard’s book titled ‘The End of Detroit’ that once again points to the persistent underlying problem of the US car manufacturers as an ‘inability to provide good-quality vehicles that Americans keep wanting to buy, and at premium prices’ (Grant 2003,p10).

As regards quality in Japanese production, an impressive feature of this account was that if one were an academic and dependent on western publications to identify and describe the technical source of Japanese advantage, for much of the time you were in possession of a partial and outdated picture of practice. In contrast, western firms were in a position to gain a direct understanding of Japanese practice by buying into Japanese firms (for example, Ford acquired a stake in Mazda) and setting up joint manufacturing ventures. As we will see below, even such close organisational relationships did not guarantee an adequate organisational response.

With this overview of changes in analytical fashion in mind, we are in a position to reassess the value of the stories of Japanese unique shop floor and model design practices, for the clues they provided that the Japanese car manufacturers were doing something different with their organisations. In doing so we will be examining an important example of a very common process: how firms identify and attempt to transfer the proprietary know-how of successful rivals. Today, this is sometimes referred to as ‘benchmarking’, but the way that term is used often implies that the relevant information is available if you can be bothered to look. In practice, as to an extent we have already seen, the problem is how to establish the value of the available ‘information’ when there are competing
explanations for your rivals’ success. The rivals have no interest in helping you. It is a problem of developing knowledge, or understanding, not simply of comparative metrics – although metrics remain a useful way of organising data to aid the detection of patterns in practice.

**Innovative shop floor practice as the basis of competitive advantage**

A listing and description of the full set of Japanese manufacturing techniques after two decades would be besides the point; what they collectively demonstrated was a sustained and determined creativity on the shop floor by engineers and workers. Some, like kanban\(^3\) were original attempts to control inventory and others, like preventive maintenance, were already well known but not widely used in the car industry. Some more clearly demonstrated engineering ingenuity on the shop floor, such as the much-cited reduction of set up time in the Toyota sheet steel press room; this involved the creation of a revolving table of adjustable height so that press dies could be slid on to the table, the table revolved and a new die slid from the table into position on the press (Monden 1983,p76-79). The numbers attached to the effort to reduce set-up time also gave some sense of the sustained effort involved in generating the achievements. According to Monden, the Toyota press shop set up time was reduced from 2 or 3 hours in 1954 to 15 minutes by 1964, and after 1970 this was further reduced to 3 minutes (Monden 1983,p8). These achievements were not the product of an overnight flash of genius, but of a long period of trial and error experimentation by both engineers and workers on the organisation of work and the design of shop floor artefacts.

Another long-lived insight came when comparisons between established western and Japanese practice revealed that some of the academic theorising about mass production operations had inadvertently helped block the development of better practice, rather than aid it. This was the case with the idea of an ‘economic order quantity’ (EOQ), a theoretically

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\(^3\) Kanban is an ingenious distributed information feedback practice that ensures parts are only manufactured in response to demand from final assembly. Kanban involves the attachment of cards to each item of inventory and only allowing the manufacture of a part at a workstation when a returned and detached card indicates that its part has been used in a later production process. If the number of cards is reduced the number of items of inventory is reduced. The idea is to force down the number of parts until problems matching supply and demand are encountered. The progressive solution of these revealed problems generates the more efficient production process. See (Monden 1983,p13ff).
ideal number for the size of a batch of manufactured parts. The derivation of an EOQ was once a staple of operations management textbooks and was calculated as a trade off between the overhead cost of machine set up time, which reduced per unit part as batch size was increased, and the variable ‘carrying cost’ of storing parts that could not immediately be used. The problem was that to model the problem in this way the EOQ assumed that set up time was fixed, rather than a form of cost that could be driven down through creative shop floor thinking.  

A last instructive contrast that was made at the time was between a ‘western’ presumption that quality was the final responsibility of inspectors at the end of a production line, and the ‘Japanese’ method of keeping responsibility for quality with the workforce. If the quality of delivered products depended on final inspection, then it was natural to associate the achievement of higher customer-delivered quality with the greater costs of more thorough final inspection. The rule of thumb became to assume that higher delivered product quality cost more. In contrast, in the Toyota Production System, the reduction of inventory and costs was closely associated with the solution of a host of quality-related problems in cooperation with the workforce, so that rising production quality was associated with decreasing costs.

A lesson here was that the mathematical modelling of existing production practices had proved to be a diversion from the creative transformation of that practice. Another was that the immediate objects of new practice were savings in simple physical terms, for example, less floor space for storage, less time for machine set up, reductions in numbers of breakdowns, reductions in inventory. Success in the reduction of these physical parameters in the working production line could be relied upon to translate into economic gain.

Innovation in new model design and competitive advantage

The design of new models of car is an extremely costly activity, as shown by General Motors GM-10 project for four new models in the 1980s, budgeted to cost $7 billion and take 5 years, but running to 7 years (Womack, Jones and Roos 1990,p106). Such high design costs obviously

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4 See for example (Schonberger 1982,p22-24).
limit the frequency of redesign and the variety of models mass producers are willing to offer their customers. So Clark, Chew and Fujimoto’s evidence of a great gap in the efficiency of the model design process between Japanese and western producers implied an enormous competitive advantage lay with the Japanese.

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<td>Delay of introduction date</td>
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Note - Number of engineering hours has been standardised by an attempt to take account of variation in project scope (Clark, Chew and Fujimoto 1987, p744). Size of team was estimated from a different selection of data (Clark, Chew and Fujimoto 1987, p755).

Figure 1 New model car design compared in US, Japan and Europe, abstracted from Clark, Chew and Fujimoto (Clark, Chew and Fujimoto 1987, p741).

Not only was the Japanese design process cheaper and faster, but Womack, Jones and Roos also document some evidence that Japanese design was a significant source of quality and productivity advantage on the shop floor. This occurred because the Japanese were good at designing cars that were easy to manufacture; in practice this means that cars were designed to be built with fewer parts, and parts were designed to be easier to assemble⁶ (Womack, Jones and Roos 1990, p96).

⁶ The evidence comprises of a survey of car producers’ opinions of which of their competitors were better at design for manufacture, and a General Motors study comparing one of its own plants with a Ford plant through ‘tear down analysis’ – the practice of dismantling a competitor’s product to deduce the design of their assembly plant. A survey and one two-plant comparison are suggestive, but provide only a thin basis for confidence in exact percentage figures for the role of design on shop floor productivity and quality (Womack, Jones and Roos 1990, p96).
As discussed above, this new evidence reduced the explanatory burden previously placed on Japanese shop floor technique. Altogether, the evidence was overwhelming that the Japanese were able to manufacture cheaper, higher quality (lower number of defects in production) cars because of their distinctive achievements in the reorganisation of both the design process and the shop floor.

An obvious question is whether their western rivals would be able to copy their achievement once they understood it. The answer to this question is not strictly separable from the answer to another: what enabled these Japanese companies to move from a technologically backward position to a leading position? The answer to both questions involves the characteristic Japanese industrial organisation of the keiretsu and the associated institution that it serves to maintain: the ‘Japanese employment system’. The next section teases out the connection between work practices and industrial organisation, using the example of the organisational practices most clearly linked to the achievement of efficiency in new car model design.

*From the organisational practices that support superior design to distinctive institutions*

At least the Japanese shop floor practices were visible to informed plant visitors such as Monden and Schonberger. Clark, Chew and Fujimoto had to identify the less visible project management practices behind the achievement of more efficient and effective new model design. They explain that in the best of the Japanese projects,

‘…a heavyweight project manager leads a multifunctional team, in which problem-solving cycles are overlapped and closely linked through intensive dialogue’ (Clark, Chew and Fujimoto 1987, p766).

This requires some explanation. The design of a new model range in the car industry historically took place within the functional departments of the companies and was coordinated by the normal management hierarchy. From the 1960s a trend became established to manage new product development as a distinct project, a trend most pronounced in Japan. Yet the degree of project management organisation varied considerably and for convenience Clark’s researchers distinguished between ‘light’ and ‘heavy’
weight project management; lightweight managers had responsibility for the coordination of development, but little control over the content of the project. The development work continued to take place in the functional departments. In contrast the heavyweight project manager is,

‘…not only a coordinator but a concept champion with direct responsibility for all aspects of the project. He or she has strong influence outside the development group, works directly with the engineers (creates a project team) and has high status within the organisation (equivalent to a major functional department…)’ (Clark, Chew and Fujimoto 1987,p752).

This relative power and prestige of the project leader could be enhanced by devices such as that in Toyota, where the new model project leader position was seen as the traditional stepping-stone to the leadership of the entire company. It attracted the company’s better and more ambitious people (Womack, Jones and Roos 1990,p112).

Many of the quality and productivity achievements of heavy weight teams are related to their superior ability to manage the general characteristics of large-scale projects. In order to understand the significance of the Japanese achievement, these need to be briefly introduced.

The problem of managing large scale projects of work arises in many industries; the construction industry and software writing are obvious examples. Such projects consist of many defined tasks, some of which can be pursued simultaneously, in principle shortening project lifetime. Actual project lifetime is, however, determined by the organisation of the class of tasks that require the completion of other tasks before they are begun. A sequence of dependent tasks forms a path of work, and many such paths may run in parallel in a project. The longest sequence of dependent tasks is called the ‘critical path’ and it is this critical path that effectively defines the minimum time to project completion. Any delay on the critical path delays the whole project and so it is the critical path that deserves the closest management monitoring. An early, classic and relevant account of the problems of project management is Frederick Brooks’ essay ‘The Mythical Man Month’ based on his experience as the manager of the writing of the IBM Operating System 360 software (Brooks 1995).
Relevant to car design is Brooks’ explanation of why project schedules always slip. The blame rests partly on the optimism of designers, who assume that each of the many sequenced tasks that comprise a major design project will only take the time that they ‘ought’ to take. Brooks also places blame on the unit of work used to schedule projects, the ‘man-month’. This unit provides a temptation to assume that men and months are interchangeable: as if a doubling of workers on a task should halve the time taken. As Brooks expresses it, although project cost does vary as the product of the number of workers employed and the number of months worked, progress does not, because of communication costs (Brooks 1995,p17). Communication costs take a number of forms. New workers must be trained in the project design and typically by the already competent workers, but worse, if work is repartitioned to enable these new workers to be put to work, and if that partitioning raises the necessity for worker intercommunication to coordinate design, then the time required to communicate may outweigh the expected time savings from the rescheduling of the work. In these circumstances a paradox arises: if management give in to the temptation to add more workers in an attempt to restore a slipping schedule, the result is instead to lengthen the schedule, to add to its expense, and because of the increased complexity of communication within the project, ‘without a doubt’ to yield a poorer product (Brooks 1995,p25).

The same description of dysfunctional project management is given by Womack et al. when they describe the management of car design within the functional departments of the car industry (Womack, Jones and Roos 1990,p115). Car design shares with systems programming this characteristic of a complex interdependency of tasks that require significant worker communication as part of the necessary coordination. Brooks’ description of the effects of attempting to restore a slipping project schedule makes sense of the outstanding feature of project management in car design; the heavyweight teams had small numbers of multifunction engineers which facilitated effective worker communication and so the efficiency and quality of design. In contrast, some of the US firms had overspecialised their engineers - one firm had specialist door lock designers (Clark, Chew and Fujimoto 1987) – and this drove up the

7 Brooks models this by pointing out that if each task must be independently coordinated with each other task, then the communication effort increases in proportion to the number of communicating worker pairs, or n (n-1)/2, where n is the number of communicating workers. So, for example, doubling the number of workers, quadruples the effort spent communicating (Brooks 1995,p18).
size of design teams. Larger teams demanded disproportionately more coordination time and created more opportunities for slippage – for diseconomies of scale - as coordination of interrelated tasks became difficult.

Now we are in a position to understand some of the more exotic means the Japanese firms developed to reduce project lead-time. Because the teams were smaller they carried a lower intrinsic time burden of task coordination. This allowed them to more closely coordinate innovative efforts to reduce, rather than simply manage, the critical path itself. The prime example of this given by Clark’s researchers was the achievement of a great degree of ‘overlap’ of the most important critical path tasks, i.e. the achievement of a degree of simultaneous work on two tasks, where normally one would only begin upon the completion of the other (Clark, Chew and Fujimoto 1987,p756ff). The greater the degree of overlapping of tasks that lie on the critical path, the shorter it is possible to make the project lifetime.

This idea really needs a concrete example and Clark’s team give us the case of the design and development of the hardened steel dies used for pressing steel body panels (Clark, Chew and Fujimoto 1987,p760). Overlap took the form of starting the rough cutting of the dies before the final panel shapes had been decided, a practice that depended for its success on close communication between the panel design and die design engineers. The best practitioners had shortened the development time for dies from two years to one8 (Womack, Jones and Roos 1990,p117).

Since Clark, Chew and Fujimoto’s article, this practice of overlapping project activities has become popularly known as ‘simultaneous development’ or ‘concurrent engineering’ and, divorced from its car industry context, is widely advocated as the means of reducing project lead times – as a casual internet search will reveal. It is obvious from the context that unless other technology design processes have disproportionately long tasks on the critical path, such as die formation, there will be no good targets for critical path reduction. If the effort is nevertheless made to overlap tasks on the critical path, there will be a

8 The process takes so long because the process of creep grinding is used to shape hardened steel blocks into dies. Creep grinding, as its name suggests, is a very slow process, slow on the order of years rather than months.
much lower prospective return in terms of time saved, yet an increased overhead of communication costs – and so an increased likelihood of slippage and diseconomies of scale. Given the normal problems of project management, design projects without an outstandingly long task on the critical path would be better advised to concentrate on good project management: the effective definition of tasks and the identification of the critical path itself. In Brooks’ account, this is difficult enough, and attempts to cleverly complicate project management result in more slippage and worse project quality. This argument for caution depends only on the task length characteristics of design project work. There were other organisational and expertise reasons why the Japanese achievement of simultaneous engineering was possible.

The key question is how the Japanese kept their design teams small and effective. In the first instance, small size was only possible because of the breadth of functional knowledge possessed by the individual engineers in the team; fewer individuals were needed to cover the necessary areas of expertise. This only begs the question of how this was achieved. So we turn to the question of how the elite Japanese industrial company distinctively forms its engineering talent, a question that nicely bears on their shop floor achievements.

The Distinctive Formation of Japanese Engineers and the Japanese Employment System

In contrast to western firms, Japanese graduate engineers typically begin their careers working on the shop floor. The historian Morikawa argues that this practice was originally supported by Japanese firms’ urgent need to transfer technology from the west (Morikawa 1991,p138). The shop floor became something of a laboratory employing a high concentration of engineers as technology implementation problem solvers. Long after Japan passed the acute phase of technology catch up with the west, this practice of initiating engineers to the shop floor continued. Morikawa argues it had always formed part of the elite Japanese engineering schools’ understanding of what an engineer should be (Morikawa 1991,p138). Whatever the explanation, the practice became so widespread that in Japan ‘to work exclusively in the office or on research and development is not to be, by definition, an engineer at all’ (Morikawa 1991,p136). Again, this stands in contrast to the west where immediate specialisation in such employment niches are accepted career paths for graduate engineers.
Shop floor experience is only the beginning of systematic job rotation through other functional departments that gives the Japanese engineer a broad experience of the industrial firm. This broad experience allows Japanese engineers to become the typical feedstock for promotion into the management hierarchy.

This distinctive use of the engineer helps makes sense both of the achievement of innovation on the shop floor and model design. In particular, such achievements as set up time reduction, that involved the reengineering of equipment, required engineers to cooperate with blue-collar workers over long periods of time. The achievement of the necessarily small, heavyweight teams in design was possible because the members already shared much experience of each other’s nominal functional specialities. This was an obvious aid to communication, but it also allowed fewer individuals to represent the necessary fields of expertise.

The story of Japanese engineers’ distinctiveness is not complete until the features of the Japanese employment system are described, for the work, motivation and careers of engineers are moulded by that system in the elite industrial companies. The dominant view within Japan is that there are ‘three pillars’ of the employment system that are intimately connected; lifetime employment, a seniority-plus-merit wage and promotion system and enterprise unions (Johnson 1982,p11; Whittaker 1990,p5).

Lifetime employment allows the company to invest heavily in costly forms of training – such as job rotation – and yet remain confident that it will reap the returns on this investment, rather than some employee-poaching competitor. Lifetime employment is itself facilitated by ‘nenko’ - the rewarding of employees over long, rather than short time periods. Nenko describes the practice where employees cannot be promoted rapidly and above their seniors, but that as they age, if they are thought to have merit, they will gradually move up the ‘career escalator’, a term that captures the somewhat automatic nature of the process (Woronoff 1993,p85). Finally, enterprise unions represent the workforce of a particular Japanese company, rather than the workers in an industry (industrial unions) or an occupation (craft unions) (Whittaker 1990,p85). Some of the advantages of the Japanese employment system for the management of technology can be expressed as the avoidance of negative outcomes: of insufficient and inadequately broad training; of overspecialisation in some niche of
technical expertise; of individual commitment to organisations other than the company, such as unions or occupational or professional groups.

The Japanese employment system represents an extreme form of reliance on internal management instead of the labour market for the skills, experience and expertise needed by a company. In Du Pont or IBM we already have examples of western companies that have used market control to modify employment practices in a similar manner to the Japanese elite companies – by extending security of employment to their engineers and scientists. A difference is that when the source of that market control declined – when they lost their leading and innovative position in product markets - so did the ability of the company to extend security to its workforce.

There is a fundamental difference in industrial organisation between such leading western companies and the Japanese industrial firms – and so in the institutional basis for the control of the labour market. The elite Japanese industrial companies are invariably grouped around a big bank and a general trading company, a characteristic Japanese form of industrial organisation termed a keiretsu. From the 1950s the economy became dominated by 20-odd large keiretsu that were effectively financially underwritten by the Bank of Japan itself (Johnson 1982,p206).

This distinctive industrial structure underpins the employment system. The number of keiretsu is small enough that they are able to enforce the norm of not poaching core employees from each other. An engineering graduate or core worker joins a single keiretsu group for the life of their career and cannot ‘job-hop’ between companies affiliated to different keiretsu in search of promotion; in return the keiretsu offers the security of lifetime employment, extensive training and a broader range of employment and promotion opportunities within the group than any single western company could offer.

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9 Keiretsu organisation itself has antecedents in the zaibatsu, the giant shogun family-controlled industrial firms of pre-war Japan that were broken up by the post-war US occupying forces (Johnson 1982,p174). Once the occupying forces left, the Japanese economic bureaucracy MITI encouraged more than 2800 trading companies to group into 20 large companies each affiliated to a different keiretsu (Johnson 1982,p206).
The obvious disadvantage of the extension of lifetime employment to a core workforce would appear to be its inflexibility with respect to changing economic conditions and company retrenchments. Ronald Dore, in his pioneering comparison of two British with two Japanese factories certainly showed that in the face of such market shocks, extraordinary efforts are made by management to retain the core workforce (Dore 1973). Among the practices Dore identified in his comparison of Hitachi and English Electric plants: Hitachi’s use of an expendable group of temporary workers; the minimising of in-house machining and fabrication in good times so that during demand-troughs outside suppliers could be dropped; a greater ability to redeploy the very broadly trained core workforce between different types of work; a willingness to retrain any workers made redundant by changing technology; and because of its greater product range, a greater ability to transfer workers out of declining product areas while remaining within the Hitachi group of companies (Dore 1973). In sum, Hitachi made great efforts to extend a high degree of security to its core workforce relative to ordinary workers in the economy, and to its own temporary workers. In exchange, Hitachi obtained a skilled and flexible workforce committed to the company. Even the scourge of ‘Japanapologists’, Jon Woronoff, would surely not disagree with this brief summary of the positive features of the system. To be sure, this system transfers insecurity down the supply chain, but it retains security where it is most needed, in the companies that control final assembly and so the quality of the product delivered to the consumer. These elite companies are the ones that have the potential and the incentive to control product quality throughout the supply chain.

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10 Nor does one have to believe that company-committed workers are necessarily ‘happy’ workers. On this question, Berggren’s careful study of worker conditions in a lean production car plant in the US drew mixed conclusions - workers were paid more, had more responsibility and control over their work, but worked more relentlessly and longer than in the conventional mass production car plants. They cannot be said to be clearly worse off in such a system..(Berggren 1993).
11 Woronoff allows that the Japanese system has created a first class export-oriented production system, his attacks are directed against those that imagine that all aspects of the Japanese economy or society are equally marvellous.
12 For reasons of space I have not explored Japanese management of the supply chain. Whether from Dore, Womack et al. or other authors, the essential feature of the techniques used in supplier relationships is that they are supported by a long term and high trust relationship between buyer and supplier. In essence, in exchange for continuity of orders, the industrial keiretsu company wields considerable power over the practices of its suppliers. If expanded to the level of practices, the argument would parallel the one assembled here with respect to design and shop floor practices.
This account linked the generation of distinctive Japanese shop floor and design practices to the possession of an equally distinctive employment system that was itself embedded in a distinctive model of industrial organisation. Only now are we in a position to discuss whether the Japanese achievements in the management of technology are transferable as disembodied techniques to their western rivals.

*The question of transferability of innovative Japanese technique in the absence of supportive institutions*

The discussion of such apparently alien institutions as keiretsu naturally throws doubt on any easy assumptions that full transfer of ‘Japanese’ practice is possible, or will be easy, or quick. No western country is likely to introduce keiretsu industrial organisation. On the other hand, as already argued, the organisational advantages that keiretsu structure spreads so widely within the elite Japanese industrial companies are not alien to western economies and companies, as the examples of Du Pont, IBM and other innovating western companies demonstrate. Whereas a common source of the leading western firms’ product market control has been through the maintenance of an innovative lead over their rivals, the Japanese industrial firms depend on an industrial structure that, like the financial institutions of over-loaning, was originally created to aid technological catch-up with the west. In other words, the institutional means by which leading companies in both Japan and the west gained a degree of control over product markets may have been very different: they are nevertheless similar in that a degree of product market control was obtained and similar again in the way that this control was exploited to extend such qualities as security to elite employees in exchange for those employees’ commitment to the company.

So it is possible to move the argument away from the significance of stark institutional differences. What matters is that wherever a degree of market control exists, the potential exists for companies to learn how to emulate foreign best practice. That does not mean technological catch-up, or overhaul of rivals can be taken for granted, or expected on any deterministic timescale.

The reasons are familiar from the car industry example; it took time to perceive the threat accurately, it took time for companies to experiment and find out what aided technique transfer. The quantitative evidence
shows that by the end of the 1980s US-Japanese joint venture car plants in the US had productivity and quality levels similar to Japanese plant located in Japan. The car industry might be thought to be exceptional, because there are relatively recent published quality and productivity statistics - a result of an unusual degree of individual company openness, also partly a result of the US government being willing to threaten Japanese producers with import tariffs.

If a general appraisal of the result of the US quality movement is wanted, it would be difficult to improve on the assessment of Robert Cole, an academic specialising in its study. Cole is upbeat about the progress that large US firms have made in closing the quality gap with the leading Japanese exporting firms (Cole 1998). After acknowledging the early 1980s problems in identifying the scale and nature of the threat from Japanese quality practices, he describes the way that the US quality movement and principles developed,

...what we saw manifested in the large manufacturing firms were typically very partial versions of these principles, characterised by a bewildering mix of creative hybrids and degraded mutations. Such efforts tended to frustrate the quality zealots who railed against incomplete practices that failed to realise the true vision. The partial version also led scholars to dismiss the whole effort as a failed fad. Yet, such conclusions cannot account for the demonstrable improvement in quality across a broad range of manufacturing industries over the last decade and a half. A more plausible view is that many of these large firms adopted just enough of the various principles, often without the fanfare of faddish acronyms, and in a sufficiently pragmatic and creative way... that markedly improved their quality performance (Cole 1998,p62).

In this view, as important as the initiatives of companies was the development of a rich infrastructure of non-market bodies, such as quality awarding bodies. The origin of these was when the Japanese government

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13 For example, by collaborating with its part-owned partner Mazda, Ford had achieved comparable results to the Japanese in new plant by 1989 (Womack, Jones and Roos 1990,p86).
had in the early post-war years invited US quality experts such as WE Deming, J Juran and AV Feigenbaum to tour the country to speak to management audiences. Such was the Japanese enthusiasm that they created the world’s first ‘Deming Prize’ for quality in industrial firms (Johnson 1982,p216). The idea that US experts had contributed to Japanese success was particularly galling in the US: it also weighed in favour of the idea that US firms, by adopting the US experts’ ideas, would be able to replicate the Japanese achievement. There grew an obsessive US interest in those experts most associated with quality such as Deming, Juran and Feigenbaum. There are now both Deming and Juran Institutes in the US, multiple US quality prizes, and publications galore on ‘quality’, especially, by the 1990s, syntheses and derivations of the experts’ practices and recommendations under the term ‘Total Quality Management’ (TQM).\(^{14}\)

Important also was the activity of consultants; by 1992 Business Week could estimate that American companies were paying out 750m dollars a year to third party suppliers of ‘advice and materials on quality’ (Cole 1998,p68). In this instance then, consultants proved to be valuable diffusers of the knowledge of what worked between firms.

It is worth pointing out that what we might call institutional innovation external to firms was an important part of both the US and Japanese responses to their perceived technology gaps - the Japanese response was of course the more far-reaching and the gap they sought to close was much the greater.

*Modularisation and outsourcing – the Japanese lead challenged?*

At first sight some of the perceived trends in the organisation of production of the late 1990s, such as out-sourcing and modularisation, might appear to contradict the identification of Japanese success with their superior modes of managing in-house design and production. Yet there is not necessarily a contradiction, because as argued by writers such as Pavitt, it is the advent of more effective information and communication technologies (ICT) that have made outsourcing a more available option for firms. ICTs allow geographical separation because they improve the ability of the firm to do such things as exchange detailed product

\(^{14}\) One of the better examples is the book by Oakland. It is worth pointing out that despite the superficial appearance of comprehensiveness, like Schonberger and Monden, the details of innovative achievement in the Japanese organisation of new model design is simply absent, despite Clark’s research being by then available (Oakland 1989).
specifications with suppliers and to maintain supervisory control over distant production sites (Pavitt 2003,p84). In Pavitt’s schema the modularisation of production also aids the practice of outsourcing because if the specifications of subassemblies of components – modules - can be accurately specified and not changed over time, then they can be reliably outsourced. Pavitt is careful to point out that where personal transfers are necessary and tacit knowledge of production is important, there will be limits on the degree of outsourcing possible. Nevertheless, he is willing to speculate on where this trend might lead; towards an increasing split between firms specialising in ‘systems integration’ and manufacturing firms, with systems integration firms competing in ‘innovations in the design, development, integration and marketing of increasingly complex products and systems’ (Pavitt 2003,p88). The tendency for manufacturing to be outsourced to low wage countries might accentuate and,

‘…the high-skilled ‘services’ in which the high-wage countries specialize would not be ‘immaterial’ in the conventional sense. They would comprise high-tech machines (processing information rather than materials), mastery of the knowledge underlying manufacturing, and a capacity for designing, integrating and supporting complex physical systems, including simulations and modelling products and processes, production and logistic operations, monitoring and control and customer support: in other words, the skilled activities that manufacturing firms undertake except manufacturing itself (Pavitt 2003,p88).

It is a grand future scenario, but one may doubt whether it is realisable or desirable in practice in all industries, and fear the consequences for firms if they persuade themselves that such a scenario is their immediate future. The story of modularisation in the car industry serves as a cautionary tale warning us not to jump to the conclusion that modularisation and outsourcing are inevitable trends of the future.

By 2003 the outsourcing of modules had become the favoured panacea for the problems of the car industry (Sako 2003,p229). She points out that ‘in theory modularity captures the notion of a clear division of labour between the architect with architectural design knowledge and designers with knowledge of each module’ (Sako 2003,p230). In other words, for modularisation to work, the
architectural designer with knowledge of how to design an entire system – for example a range of car models - must have a dependable division of labour between their work and the work of those who design the modules which make up the total system. If the boundary between modules and the content of modules is unstable, then there is less scope for economies through the division of design labour: in the language of an earlier section, communication costs and coordination costs will be higher. So it is relevant that when Sako studied the composition of two proposed modules, the car cockpit and the car door, she found that the ‘product architecture of a car differs substantially from model to model and that the notion of mixing and matching, or sharing and reusing modules across models, never mind across OEMs, is not generally possible due to large variations in modular boundaries’ (Sako 2003,p234). The variability of module definitions meant the posited economic gains of modularisation would be largely unavailable.

Sako also noted that the large car manufacturers were attempting to retain their systems integration capability even as they sought to modularise and outsource (Sako 2003,p239). In other words, the car manufacturers were not rushing to reap economies by the selective abandonment of in-house design capability to module suppliers, but through its retention were hedging on the success of their outsourcing efforts. Once again and as for the case of module variability, the theoretical economies of modularisation were not being seized in practice.

This situation prompts Sako to suggest something quite radical: that ‘the popularity of the notion of modularisation in the United States and Europe may in part be due to the hope that it might enable the retention of, or reversion to, arms’-length trading with suppliers without being locked into any committed relationships’ (Sako 2003,p241). In other words, faced with the Japanese organisational advantages in integrated design and committed supplier relationships, rather than face the difficult struggle to imitate these, US and European firms have preferred to believe that they can solve their problems with a package of practices that actually demand a lesser degree of change from current practice.
This interpretation gains strength from Takeishi and Fujimoto’s work on recent developments in Japanese car manufacturers (Takeishi and Fujimoto 2003). Their questionnaire to Japanese component suppliers revealed the greatest change in practice to have been a ‘shift to integral architecture’ (Takeishi and Fujimoto 2003, p263). The functions assigned to individual parts had become more complex and ‘the need for… functional coordination with other components had increased (Takeishi and Fujimoto 2003, p263). As the authors point out, these changes ‘were in an opposite direction to modularization (Takeishi and Fujimoto 2003, p263). On the other hand they did find some increase in the number of components assigned to subassemblies in the major manufacturers, but at the cost of some flexibility in manufacture. Overall, their picture is that the Japanese industry was interested in an increased degree of modularisation in production, but not as a means towards outsourcing, while the European industry has been motivated primarily by the predicted economies of outsourcing.

Sako goes on to list and to query the motivation for modularisation in the car industry. Some of her ‘strategic drivers’ are not concerned with economics or the experience of customer demand in the car industry; they include dubious comparisons with customer demand in the personal computer industry and pure financial engineering in the desire to raise share values through shifting asset ownership to suppliers. This is an obviously ephemeral motivation and suggests that the interest in modularisation in the car industry may prove something of a fashion.

The situation appears to be that the Japanese style of highly-integrated design and manufacture continues to compete with a more disintegrated Western style of design and manufacture. Given that the Japanese are the leaders in effective design and manufacture it is suspicious that it is not they, but the follower Western firms that are experimenting with modularisation and especially outsourcing. These are early days to make any definitive judgements on outcomes, but if Sako’s suspicions are borne

\[\text{15 This motivation arose at the time of the dot.com boom, when the share valuations of the major car-makers plummeted. There arose the belief that these companies could improve their measured return on assets (ROA) by shifting more of those under-rated assets to suppliers – it was argued that this was necessary to raise their share values (Sako 2003, p245).}\]
out, the experiments with modularisation and outsourcing may yet prove to be a distraction and a dead-end at this point in the industry’s evolution. There is then, no reason here to reject the idea from an earlier section that the Japanese keiretsu industrial organisation underpins the distinct employment practices that allow the development of a superior ability to design and manufacture products. And this in turn raises some doubts about the realisation of Pavitt’s grand future scenario of a division of labour between ‘high-skilled service’ firms in the industrialised countries and manufacturing in the low-cost countries. Where the innovative gains through a cycle of design depend on knowledge of the entire manufacturing process, of comprehensive knowledge of the potential for redesign of all components, then modularisation may introduce inflexibility in design and production and manufacturing may need to be kept in-house as the better means of developing and retaining this comprehensive knowledge. In a nutshell, while modularisation is an established fact in certain industries, especially within electronics, there may be some industries, such as car manufacture, where the nature of technological change renders it inappropriate.

**The Dematerialisation of Technique and the Generation of Management Fad – TQM ‘diffusion’**

There was an element of fashion in the adoption of modularisation in the car industry and this is a good point at which to address the phenomenon of fashion in the adoption of practice in greater depth. As mentioned above, one of the most visible reactions to evidence of superior Japanese practice was the institution of a ‘quality movement’ in western countries, with the aim of improving existing practice. TQM became one of the most widespread management ‘innovations’ of the 1990s and remains one of the most intriguing because of its origins in a genuine achievement within a known technology. Could it be the means by which western firms could duplicate the Japanese achievement? The scale of claims of adoption and the volume of derivative advocacy-texts remains impressive today. Some idea of the phenomenon can be quickly garnered; a Google search on ‘TQM’ yields 275 000 web entries and an Amazon.com search yields 135 entries for books. The question one would like to answer is whether TQM provided a genuine method of improving the quality of goods and services or was largely a vacuous fad.

*The mutation of technique meaning during implementation*

The first and outstanding feature of TQM, shared with other management fads, is that it is not an ‘it’, but a mutable entity, a package of concepts and
techniques prone to change from one publication to another and from one organisation to another. One review of TQM research and practice begins,

‘There is now such diversity of things done under the name “total quality” that it has become unclear whether TQM still has an identifiable conceptual core, if it ever did… Most organizational scholars who have responded to the call for TQM research have focused their theoretical efforts on refining definitions of TQM… (Hackman and Wageman 1995,p310)

‘Had we attempted to organize our thoughts exclusively around contemporary TQM practice rather than use the philosophy and prescriptions of the TQM founders… it would have been impossible to write’ (Hackman and Wageman 1995,p338)

This characteristic of mutable meaning in practice appears to be the outstanding feature of management fads. It is, for example, a feature of the Business Process Reengineering (BPR) fad that followed close on the heels of TQM. BPR consisted of various exhortations to restructure business processes, loosely linked to IT implementation. Jones and Grint are two examples of authors that could find little coherence of content between different BPR texts and no originality whatsoever in the constituent elements of the BPR ‘concept’ (Grint 1995; Jones 1995).

This is enormously significant, for if an entity has no stable content, serious analysis of its general value-claims is not possible. What is possible and interesting in its own right is to study the process by which the meaning of a fad like TQM mutated in implementation so that it became a pseudo-innovation. This is perhaps most clear for a single-technique fad like Quality Circles (QCs) than for the mutable bundle of practices represented by TQM.

From  euphoric adoption to failed implementation in Quality Circles

Quality Circles (QCs) provide an early example of a technique that swept through western companies in the early to mid-1980s, as part of the search for production improvement but also as a means of improving employee relations through participation. Light is thrown on the process of their implementation by Stephen Hill’s research into thirteen British companies that had pioneered QCs in the early 1980s (Hill 1991,p544). By the end of
1989 only two of these companies still maintained a QC programme (Hill 1991,p545).

Hill’s managers could not report that QCs had improved employee relations, evidenced by low and declining levels of voluntary worker participation and continuing hostility to QCs amongst a minority of workers (Hill 1991,p547). Every firm claimed some business improvements had resulted from QCs, but that the ‘measurable return was seen as disappointing and as declining over time until circles contributed little’ (Hill 1991,p548). The two firms that maintained programmes in 1989 did so for social rather than economic reasons.

An important reason for failure was ‘organisational dualism’, whereby QCs were established in parallel to the normal hierarchical lines of control. The middle managers responsible for making QCs work now had two lines of responsibility (Hill 1991,p549). Such managers were responsible for ‘overseeing’ circles, but were not empowered to choose circle members or to set the circle agenda and were not able to be rewarded for their circle work (Hill 1991,p550). Yet while circles analysed and proposed solutions to problems, they relied on these middle managers to decide to implement their solutions. Given the poor integration of circle responsibilities into middle manager roles, it is perhaps not surprising that obstructive and reluctant management was the most frequently mentioned problem by circle members (Hill 1991,p550).

This picture of QC implementation contrasted with a detailed study of Japanese QC practice that undermined the widely accepted idea that QCs were voluntary (Hill 1991,p550). In Japanese practice considerable pressure was brought to bear on both middle managers and workers to participate in QC activities. This picture of ‘enforced voluntarism’ certainly fits Satoshi Kamata’s description of his life as an autoworker on the Toyota shop floor in the mid-1970s (Kamata 1983). The British firms’ inability to integrate QCs into the organisation ‘was one of several signals that top management gave about their own apparent lack of commitment to the programme of quality improvement, after an initial period of enthusiasm’ (Hill 1991,p550).

‘The rhetoric of the early days of the boom, that circles would become a normal way of doing business, was hollow. Circles never
really took hold in the great majority of firms, remaining both experimental and marginal throughout their lives’ (Hill 1991,p551)

In sum, the British companies had implemented QC s for somewhat different objectives and in a manner distinct from the Japanese. A strong interpretation of this would be that what the British firms called QC programmes were not true QC programmes at all – and so they failed. Nevertheless, Stephen Hill remained optimistic about the prospects for QC s in the future, but as part of the package of practices represented by TQM.

*Mutation of meaning and the logic behind proliferating claims of TQM adoption*

Both Zbaracki and Hackman found a tendency for the ‘hard’ or ‘technical’ element of TQM, such as the technique of statistical process control, to be lost during its implementation (Zbaracki 1998) (Hackman and Wagaman 1995). Yet as presented by such as Deming and Juran, such statistical techniques were the very element of TQM that provided the prospect of genuine quality and productivity change for adopters. Something similar appears to have happened with Just-in-Time management (JIT), for survey evidence revealed that western firms that claimed to be adopting JIT had a distinct preference for certain techniques over others; that most radical and ‘Japanese’ of practices, kanban, attracted very little interest and in general the easier techniques were adopted, and not necessarily the most useful ones (Voss and Robinson’s work cited in (Oliver and Davies 1990,p556)).

Zbaracki’s study of five TQM adopting organisations in the US found that managers that had been trained in TQM, upon returning to their organisations, tended to drop the technical parts of TQM through ignorance and intimidation – they didn’t properly understand these parts of the programme and preferred not to stress them. What they did tend to stress were the inspirational success stories in similar organisations, for these seemed relevant and real to them (Zbaracki 1998,p615-616). His organisations included a government agency, a hotel, a defence contractor, a hospital and a manufacturing firm, but only the manufacturing firm properly implemented statistical techniques. Zbaracki concluded that at the hotel and hospital ‘the TQM program is mostly rhetoric’ – yet these two organisations were the ones with a TQM quarterly newsletter that reported only TQM success stories, whether the success stories were generated by TQM or not (Zbaracki 1998,p624). The TQM ‘technique’ that was most often claimed to be used by individuals in these organisations (95%) was brainstorming
(Zbaracki 1998,p626), but Zbaracki’s investigative interviews showed that what respondents called ‘brainstorming’ did not follow strict brainstorming rules.

Zbaracki found that what drove this mutation in all the programmes was the organisation’s internal need to demonstrate the success of the programme. Although there were some successes, there were many more project failures and difficulties in finding problems for TQM ‘solutions’. Such negative experiences were not useful in demonstrating the value of the TQM programme, and so when all Zbaracki’s organisations began to send members out to other organisations, they would do so to describe only their success stories – this evangelical practice took hold before TQM had had a chance of affecting the behaviour of the organisation. It is ironic that it was exactly such positive stories that had motivated Zbaracki’s organisations to ‘adopt’ TQM in the first place.

In this way a cycle was established where positive, inspirational stories generated new implementation attempts, then internal legitimisation needs led to the active diffusion of a heavily edited, positive-slanted and misleading version of the implementation experience. This in its turn would stimulate other organisations into adoption. The hospital, whose programme Zbaracki described as mostly rhetoric, ‘also spread news of its success. Administrators from the hospital took their best TQM story to a Juran conference. The hospital also became something of a model for surrounding hospitals’ (Zbaracki 1998,p627). Zbaracki comments on the process by which TQM mutates during implementation,

‘…in using TQM, managers generate seemingly innocuous claims that TQM has provided their organization with efficiency benefits. The evidence from the models shows that these claims, coupled with the various social psychological forces that drive out the technical content of TQM, generate increasingly inflated claims for the power of TQM and an imprecise technical meaning for TQM’ (Zbaracki 1998,p632).

We are now in the country of symbolic rhetoric rather than measurable or demonstrable change. Zbaracki nevertheless argues that despite this mutation of meaning during TQM implementation, the positive rhetoric may be useful in driving the positive results where these do occur – and there were some positive results in some of the organisations. On the other
hand, we might expect some positive change stories as a result of normal management processes in any organisation – TQM may have added nothing but its label to the otherwise unremarkable drip of occasionally positive results from management projects that are part of the background of any organisation. In addition, this cascade of positive stories creates a mounting pressure on the management of all organisations to conform to their peers; to start a TQM programme and then to claim successful adoption of TQM.

What else could be the explanation for the otherwise astonishing facts such as that, within a population of 2700 US hospitals, 73% claimed to have adopted TQM by 1993, compared to a negligible number five years previously (Westphal, Gulati and Shortell 1997, p380). The survey evidence of Westphal et al. found that early adopting hospitals may have experimented with TQM and adapted it to their individual circumstances, but later adopters simply copied the mode of implementation of the early adopters and traded ‘organizational efficiency benefits for legitimacy benefits’ (Westphal, Gulati and Shortell 1997, p388). By published efficiency measures, the later adopting hospitals were the least efficient, and as these authors argue, this finding is consistent with the idea that late adoption of TQM was primarily to symbolise that a hospital was a ‘good’ hospital.

The symbolic explanation of adoption also makes sense of the eventual abandonment of a fad, and the way that this occurs quietly and without public recantation. Once all organisations have claimed to have adopted a fad, its ability to indicate who is leading and progressive and who lagging and backward disappears, so interest suddenly dies.

Although management academics have begun to theorise about these organisational processes, they are familiar from other areas of our lives. Consider this by the US Court of Appeals judge, Richard Posner, reflecting on the career of the public intellectual James Burnham,

‘He was shameless in prophecy and undaunted by repeated falsification. In a recent study of public intellectuals, I listed the failed prophecies of a number of prominent contemporary public intellectuals, but I was wrong to think that such an exposé might discourage irresponsible prophesying. I now think the significance of such prophesying lies not in its truth-value but in its rhetorical effect. It does not really matter in the end whether the apocalyptic
prophecies of ‘The Managerial Revolution’ turned out to be true or false; they form a breathtaking, if horrific, vision of the future, and they give the book an amplitude, a resonance, and a sense of urgency that it would otherwise have lacked’ (Posner 2003, p41)

Burnham was an early exponent of a form of management cant, but if Posner’s book on public intellectuals had been a book debunking management fads, he would surely have reached a similar conclusion. Management fads’ claims of efficacy should not be judged in terms of truth-value, but as part of a package of activities that serves to symbolise, but not necessarily to contribute to, organisational progressiveness.

To sum up, it is not necessarily the case that TQM, as a synthesis of the quality experts’ ideas, is without some merit, but counts of claims of TQM adoption, as in the hospital case, are meaningless as measures of genuine change. It is right to be sceptical of the mass of claims based solely on ‘success stories’ but reasonable to believe claims on a case-by-case basis, if supporting and credible evidence is made available, as it was in the case of the car industry. Yet this cannot be expected to be usual when the object of study is current practice in organisations that have every reason to be secretive about the know-how on which their current and future profitability depends.

The kind of case evidence reviewed here, especially when carefully constructed as in Hill’s work, raises the question why senior management allowed the mutation of technique in implementation. It does not allow us a clear general answer: so it is both possible that senior management were unable to properly support implementation of the techniques in some cases and possible that they were not convinced of the value of the techniques – perhaps with some justice in the hospital case - or insufficiently motivated to manage effective implementation in others. While all these explanations may suite particular cases, a review of Prais’ matched plant studies enables us to winnow some of them as general explanatory possibilities for management behaviour.
The Organisation of the Shop Floor - Anglo-German Matched Plant Studies of Operations Management

A general quality and productivity gap between British and German manufacturers

The entire discussion of the nature, value and transferability of Japanese manufacturing techniques was motivated by Japanese firms’ successful penetration of western markets. Whereas the Japanese case concerned a relatively recent achievement by large, export-oriented industrial firms, Prais’ was concerned to explain a long-standing, superior performance of middle-sized German firms over their English equivalents. More than this, Prais’ object from the first was to demonstrate the detailed practical relationship between technical training and productivity on the shop floor (Prais 1995,pxiii). His research was conducted with the knowledge that the formal German system of technical training was superior to the British informal one.

His method was to make detailed comparisons of productivity in English and German plants. These plants were matched for size - they typically employed between 50-300 employees (neither the smallest nor the largest plant were the object of study) and simple artefacts were chosen, ranging from biscuits to springs, valves and fitted kitchen cabinets, but also including hotel service (Prais 1995,p43ff). Such simple artefacts could be expected to be manufactured in both countries and so facilitated comparison. The extent of the programme of study is evident in the more than 160 plant investigated over the period 1983 to 1991 (Prais 1995,p44). As in the case of Japanese quality practices, we want to know the nature of the gap in performance, the differences in practical management of technology and then the arguments for the source of those differences in organisational and institutional forms.

These comparisons corroborated the existence of a large productivity gap between Germany and Britain evident from the national Censuses of production. In the engineering examples of spring, screw and valve manufacture, German productivity was 63% higher than in Britain (Prais 1995,p48) and in furniture the German productivity advantage averaged 60% (Prais 1995,p51)\(^{16}\). When comparable types and quality of clothing

\(^{16}\) It is important to compare productivity per worker per unit of time. If output per worker figures are used the gross German advantage dwindles to the order of 10% - because English workers work longer hours.
were compared, the German advantage was roughly double the production per employee hour (Prais 1995,p54), but such strict productivity comparisons fail to account for major differences in quality and approach to manufacture (Prais 1995,p). This was particularly evident for biscuit manufacture, where according to the productivity measure of ‘biscuit-tons per employee hour’ the German worker produced 20% less than the British (Prais 1995,p55) - but the ‘average German biscuit’ commanded 2-3 times the retail price of the average British biscuit. The German biscuit manufacturers had moved their products so far up the quality scale that productivity was no longer a significant indicator of true difference.

Unlike manufacturing, hotel services are not subject to international competition, nor do they have the same scope for technological change. So it appears especially significant that when Prais used ‘guest-nights’ as a measure of output and full time equivalent labour as a measure of input for hotels of the same Michelin star rating, he found that German and Dutch hotels required half the labour per guest-night of the British hotels (Prais 1995,p59). This example points strongly to some national influence on the nature and organisation of employees being at the heart of the international differences in productivity.

Practices that explain the Anglo-German difference in productivity and quality of production

Prais’ researchers were able to observe that these differences in productivity were all related to a distinct and superior ability for the German firms to manage operations. This ability was in its turn directly attributed to the superior quality and quantity of technical skills available in the German, and other continental countries’ plant. Examples of the connection between poor operations management and the availability of skills show precisely what it is about skills that prove valuable on the shop floor.

So a common source of low productivity in Britain was a greater frequency of breakdown of production machinery, even when this equipment was no older than in any other country. On their physical visits to English plant, Prais researchers were able to observe and to measure the higher frequency of breakdowns; for example, emergency downtime of equipment was 10% of planned British biscuit production time, compared to an average of 3-4% in comparable continental plant – this, despite the
more complex production processes in the continental plant (Prais 1995,p62). One explanation was that,

‘Almost all continental plants carried out routine programmes of preventive maintenance – hardly any British did so; the consequences were apparent in the significantly lower rates of emergency breakdown [in the continental plant]’ (Prais 1995,p71).

The inability to maintain machinery was symptomatic of a general English inability to ‘manage’ artefacts. This was so even for such an apparently mundane matter as equipment layout in hotels; furniture and washing facilities were more often built flush with the floor to enable easy cleaning on the continent (Prais 1995,p65).

Interviews with machinery suppliers confirmed,

‘…that teething and subsequent heavy maintenance problems were significantly more prevalent among British than Continental users; British fitters’ capabilities were sometimes so low that serious ‘teething’ problems had arisen simply because installation instructions had not been correctly followed’ (Prais 1995,p64).

It is important that the English problem is hardly likely to be one of a lack of formal knowledge of best practice in these matters; rather, the firms were simply unable to deploy such practices. This view is supported by Prais’ evidence that English management sought to accommodate their acknowledged weaknesses in operations. For example, English firms recognised their weak in-house ability to manage sophisticated machine models such as CNC machines. They accommodated this weakness by tending to buy simpler machine models and delaying purchase until they were sure suppliers had dealt with all the ‘bugs’ associated with advanced models.

Of distinct significance, superior German operational capabilities enabled a strategic response to strong international competition that was denied many English firms. For example in clothing, German firms had shifted to
short production runs of 150-300 high-value items that required, for example, more complex stitching operations. This enabled them to quickly follow changes in high-value added fashion items in their home market – changes that lower cost, but distant overseas competitors found it difficult to follow. In contrast, British firms relied on longer production runs (of the order of 15,000 items) for simpler products, with less stitching, tucking and fashion variations. This left them exposed to the developing country, low-cost operators that used the same operational practices.

The frequent changes in German textile design relied on operators being able to read directly from sketches; the British operators more often relied on physical demonstration by supervisors. The limited abilities of English operators were thereby implicated in the ‘strategy’ of long production runs. Despite the lower demands that long production runs should make on supervisory overhead, overall British clothing firms employed 2.5 times more supervisors and checkers than the German plants, to correct a higher rate of error (Prais 1995, p.69). As in the US-Japanese shop floor comparisons, here we find the contrast is between more managers, higher costs and lower quality on the English side and fewer managers, lower costs and higher quality production on the German side.

Hotels provided a demonstration of the importance of another basic operations function,

‘Efficient work scheduling, we judged, was probably the single most important element in raising workforce productivity in German hotels…’ (Prais 1995, p.72).

German hotel ‘housekeepers’, the equivalent to the shop floor supervisor or foreman, spent more time on,

…”work-scheduling, stock control, purchasing, organising external services (laundry) and selecting labour saving equipment’ (Prais 1995, p.72).

75% of German housekeepers were qualified, but none of the British sample had attended any external exam (Prais 1995, p.71). The result was to force a higher level of British manager to undertake these supervisory
duties, but less effectively, and in turn this weakened the higher level managers’ ability to plan long term for such matters as marketing campaigns and the purchase of computerised booking and invoice management tools (Prais 1995,p72).

In all these comparative studies, weak English management of operations was clearly associated with low concentrations of skilled workers, but especially, as in the example of hotels, of workplace supervisors. The poor qualification of the supervisor was perhaps the greatest weakness of English operations management; in British metalworking 85% of production foremen had been promoted without any qualifications, but in German metalworking 80% of foremen had attained the relevant management Meister qualification (Prais 1995,p71). In England, as in Germany, workers were promoted from the shop floor to supervisor positions and there is no doubt that in both cases they were somehow ‘experienced’ in their work. The difference is in the structure and content of this ‘experience’. Prais’ articulation of the practical difference between the British and German supervisors is worth emphasising,

‘Someone who has followed a purely on-the-job route to learning a trade may be as competent in carrying out specified routine maintenance tasks as someone who has also attended college courses on theoretical aspects and passed written exams. But, in the modern more technically complex world, it seems he or she is less likely to be competent in knowing – sufficiently precisely and sufficiently quickly – what may have gone wrong, or is likely to go wrong, which the best way of putting it right and be able to do so in a way that ensures it will not soon go wrong again (Prais 1995,p70).

In Prais’ analysis, it is the weak English system of vocational training that explains the differences in operational performance between German and English firms.

It is not only Prais’ research that draws this conclusion. An independent series of German-French matched workplace studies drew broadly the kind of conclusions as Prais’ team – that the German vocational training system supports superior workplace organisation and performance. For example, comparisons of efforts to implement computer-integrated technologies found the French to be the less able (Lutz and Veltz 1992,p274). In
general, Lutz found that French companies had more hierarchical levels, fewer shop-floor workers as a percentage of office workers and wider wage differentials between hierarchical levels. Management and supervisory functions in these French companies took 20% of wages and salaries compared to only 12% in comparable German companies (Lutz 1992,p261). Searching for an explanation of these differences, Lutz argued that the French employment system had adapted to the graded, hierarchical and highly academic output of the French educational system by providing an equally graded occupational structure matching the hierarchy of status that the exam system generates. Although France reformed vocational training from the 1980s, this result is consistent with Prais in its resort to the structure of the dominant educational institutions to explain otherwise inexplicable features of workplace organisation.

The matched plant research offers compelling evidence of persistent international differences in the quality of operations management linked to a systematic difference in the availability of technically competent people at skilled worker and supervisory levels. These differences in the availability of technical competence are the result of great differences in the quality and extent of national systems of vocational training. Changes in operations practice are plausibly outside management control in those countries with weak national vocational training. If we want to understand how the gap in operations practice might be closed, we first have to understand how and why vocational training developed so differently in these European countries. First, it will prove relevant to consider the theoretic construct of the ‘free rider effect’ that is usually offered by economists to explain how general skills shortages can develop in the market economy.

The free rider effect in skills training

The empirical evidence suggests that the widespread English inability to manage operations well results from a general shortage of technical competence at both worker and supervisory levels. If an employer has unique skill requirements there should be no problem with the incentive to train because retention of the trained worker can be taken for granted. The free rider problem applies to the labour market for general skills: skills that all employers seek. In this situation, an employer that bears the cost of general skills training cannot be sure that the trained worker will stay with the firm after being trained, especially if there exist rival firms that refuse to train, but seek instead to use higher wages to poach skilled workers from those that do train. The free rider effect is usually described as if the
important case concerns those general skills that are already developed, but the effect can be expected to be worse in the important case of innovation. New technologies often require new skill sets that will inevitably be in short supply compared to general demand in the early stages of diffusion. When there is a mismatch between supply and demand of this sort for skills – even for established skill sets - the incentive not to train, but to poach should be expected to be greater.

Direct empirical evidence of the free rider effect should be expected to be hard to come by, since only a few cases of poaching need become known for firms to discipline their training behaviour. Nevertheless, examples of poaching behaviour are sometimes captured. James Fleck uses an example from his research into robotics implementation in the English West Midlands.  

In Fleck’s study of four small engineering firms in the West Midlands, one firm spent two years training two workers to be able to maintain and reprogram a robot installation. Near the end of this period, a second firm approached the workers, offered higher wages and successfully poached them. The first firm had taken on the risk of increased debt in its attempt to pioneer the new technology. Without the workers it had trained, and in the absence of a market for robot-operator skills, it found itself unable to operate its robot installation effectively. It soon went bankrupt. The parasitical firm then bought the first firm’s robot equipment cheap from the liquidators.

With the bankruptcy and sale of the pioneering firm’s robots to the poaching firm, this is perhaps an extreme example. The lesson it would provide within the local engineering community would nevertheless be clear; do not pioneer early stage technology and do not invest in the creation of rare technical expertise if it remains ‘free’ to move between employers in search of better employment conditions.

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17 The example has not be written up and published, except here. The reader, like myself, might believe in the veracity of the example because they trust James Fleck’s reputation as an academic. Or if they have a predilection to believe only what they can read, they might prefer to see the example as a ‘working through’ of the theoretical device of the free rider effect applied to innovation.
Here is the peculiar feature of the free rider effect for innovation – it can be expected to do its damage not so much through such spectacular cases, but through the general dampening of entrepreneurial approaches to new technologies. Of course, this is what Prais’ empirical research found: that English firms deferred implementation of new equipment and sought to purchase simpler models to reduce the complexity of implementation. Such practices can be understood as minimising the demand on shop floor skills and make sense if there is a general reluctance to train.

Apprenticeship as a Solution to the Free Rider Problem

The institutions of apprenticeship that had evolved in Europe by the medieval period can be judged as devices that overcome the free rider problem in skills provision.

Industrial states have come to differ greatly in the structure and provision of technical and vocational training especially at the intermediate or sub-degree level – the level responsible for the creation of the skilled worker. This difference is greatest between the US and UK on the one hand and continental European states such as Germany and Switzerland on the other. The rather stark differences in provision today can be explained by the different fortunes of the institution of apprenticeship in these countries.

Apprenticeship offers the employer the advantage of sub-market prices for labour in exchange for training that labour in general skills over a fixed time period - the indenture period. So apprenticeship assumes an obligation on the employer to train beyond the immediate requirements of the job and the willingness on the part of the apprentice to forego current financial rewards for the future higher wages of the skilled worker. If the system works, a versatile, generally skilled workforce is created and the problems of parasitical poaching of scarce general skills will be avoided. The institution can be expected to be particularly important in industries like engineering that are skilled-labour intensive and provide a broad product range (Elbaum 1991). The trouble with this sketch is that every feature of apprenticeship itself may be subject to forms of labour and employer abuse.

As for new skills in innovative technologies, apprenticeship institutions can only be expected to be slow to incorporate new skill requirements (the question is raised of who, if anyone, will coordinate the change in
apprenticeship content) and slow to provide sufficient stock of skilled workers in the new skills: for new technologies in high demand the institution may work as a barely adequate patch of this particularly acute form of the free rider effect.

Nevertheless, apprenticeship is the institutional mainstay of the German-speaking countries’ supply of skills. The extent and character of the institution in Germany is in remarkable contrast to the situation in England – and the US.

The extent and characteristics of the German apprenticeship institution

By the end of the 1980s, just over 60% of German 16-19 year olds took apprenticeship-level qualifications compared with 27% in Britain\(^\text{18}\) (Prais 1995,p22). Prais makes a further division between a ‘higher’, technician-level, involving more full time training and a ‘lower’, craftsman level, trained in large part at the work place, because the difference between Britain and Germany lies entirely at the craftsman, or workplace-based qualification level. Both countries have 7% of the workforce trained to technician level, but 57% of the German workforce is trained to craftsman level compared to 20% of the British\(^\text{19}\) (Prais 1995,p18). As far as technicians are produced by, and work within the large company sector, the difference between the countries emphasises that technical training is a particular problem for small and medium sized firms, where the free rider effect is most likely to operate.

These differences in raw numbers beg the question of how the institution is organised in Germany. First, the devolution of coercive power to associations of firms is a feature of the German institution. In the nineteenth century the German state introduced compulsory membership of ‘industry associations’ for firms, then transferred a variety of state functions to these self-governing associations, comprising,

\(^{18}\) This figure of 27% represented a fall in the proportion of the British workforce with apprenticeship-level qualifications, from 30% at the beginning of the 1980s (Prais 1995,p22).

\(^{19}\) In Japan also, around twice as many 18 year olds complete the equivalent technical courses as in Britain, although the mode for doing so is not that of the German ‘reformed apprenticeship’ (Prais 1995,p34.)
the entire system of vocational training, trade inspection, further training, company consulting as well as the activities of advisory committees and expert groups...' (Weimer 1992,p317).

Second, the German state has been willing to periodically intervene to reform the number of authorised apprenticeships and their duration. This has helped the institution endure in white collar occupations such as banking, hotel and retail as well as the blue-collar (Sengenberger 1992) (Gospel and Okayama 1991). By the 1990s the number of authorised apprenticeship tracks leading to skilled worker, or ‘Facharbeiter’ status had been reduced to around 380 (Prais 1995,p31) and the period of apprenticeship had been shortened to the now typical three and a half years.

Third, the value of a German certificate of practical, workplace-based attainment is secured by standardised, externally set and externally marked exams (Prais 1995,p32). This is in particular contrast to the practice of old and new British vocational qualifications: these have preferred workplace-based assessment, and worse, supervisor assessment that has the obvious defect of confusing the roles of teacher with examiner.

Fourth, in a German apprenticeship it is compulsory to continue one’s education in public vocational schools, typically for two days a week. The classroom element of German apprenticeship deserves more attention. Two English dictionary definitions of ‘academic’ are ‘excessively concerned with intellectual matters’ and ‘of purely theoretical or speculative interest’ (Collins 1991) and together these capture the British sense that there is nothing practical about academic study. In contrast, much of the German public vocational schooling consists of further study of German language and maths. That there is in fact nothing more ‘practical’ than language and mathematical ability is supported by Wolf’s review of the literature on the connection between the possession of skills and earnings. Some of the most reliable research derives from the British National Child Development Study (NCDS) where literacy and numerical ability were tested independent of any educational certificates an individual might possess, and then their earnings progress monitored over their lifetime (Wolf 2002,p33). This research confirmed that even after controlling for the level of formal qualifications achieved, high literacy and numeracy scores correlated with longer periods of employment and higher quality of work (Wolf 2002,p34). Furthermore, of all the possible
subjects for study at the British Advanced level exams for ages 17-18, only the mathematics qualification correlated with significantly higher earnings, of about ten per cent more than those who did not take the exam (Wolf 2002,p35).

The significance of this is that although the pure academic educational route has the greatest prestige in Germany, as elsewhere, after the elite performers have been channelled away into pure academic study, the bulk of an age cohort continues to study the basic academic subjects of most practical value in schools that are organised around their individual, current attainments. This not only produces a workforce of high skill and education but also a ‘very effective system for socializing young people and organizing the transition from school to working life’ (Wolf 2002,p167).

A fifth feature of German apprenticeship is that its skilled worker or ‘Facharbeiter’ status forms the basis for entry into higher-level vocational qualifications that lead into the management hierarchy. Most notable is that the Facharbeiter certificate is the starting point for a special workplace supervisor course that includes management content and that leads to the award of Meisterbrief (Prais 1995,p28). Facharbeiter is also a common entry route into the German ‘Fachhochschule’, or senior technical college, that grants qualifications in vocational subjects such as business economics or engineering at sub-degree level. This is an important source of qualifications for those who become German middle managers (Lawrence 1992,p79) (Sengenberger 1992,p251). The mass entry of teenagers into the apprenticeship system in association with this structured hierarchy of courses and standards built around the achievement of Facharbeiter status gives many more people access to the higher-level technical and management qualifications. The popularity of these courses also makes explicable the German tendency to conceive of ‘management’ as fundamentally based on technical competence – in their system, that is more often the reality than in the US and Britain. This view Germany shares with Japan and it is notable that in both countries there are structured routes for promotion from the shop floor into the management hierarchy.

All five of these features of modern German apprenticeship were, and mostly still are absent from the equivalent English institution of workplace training. A return will be made in a later section to the institutional origin of the German shop floor route into the management hierarchy, but first
the value of this and the other characteristics of the German institution are reinforced through comparison of the German with the British institutional path of development. The contrast will add to the benefits of the German employer control of the institutions of training that this also avoids the negative technology control outcomes that can arise when the workforce is left in control of skills.

**Innovation, Technology Transfer and the Craft Control of Skills**

*The craft control of skills and new technology*

Like Germany, Britain also inherited an institution of apprenticeship from the medieval period as the major means of providing shop floor skills. It developed differently, without state regulation, without coherent employer control, but as a system of informal, worker-worker, on the job learning – the craft control of skills. This institution is interesting for the contrast it provides with the institutions of employer-controlled skills, because craft control became associated with a particular and potentially hostile position with respect to new technology on the part of the workforce, and because there is reasonable evidence that it persists to the present day in the British workforce.

Lazonick has used the British cotton spinning industry to illustrate the origins of the craft control of skills in Britain. He has gone on to argue that the persistence of this institution generally inhibited the adoption of 20thc innovations in textile and other technologies in Britain (Lazonick 1990). The expression of this ‘institutional’ explanation of relative British economic decline is somewhat controversial in the economic history literature, but there is no doubt that craft control did persist in British industries and that in many instances it obstructed technological change. It at least has the role of an obstruction and source of delay to technological change, if not an outright, permanent block to change. So Lazonick’s

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20 There has been a long debate over the degree to which this and related institutional forms have acted to block British technological change. The series of papers is instructive in its own right. A good early formulation from Lazonick tends to pinpoint the vertical disintegration of the industrial structure of the British cotton industry as the institutional block to change (Lazonick 1983). Saxonhouse and Wright then cast doubt on vertical integration alone being the important factor (Saxonhouse and Wright 1984). Lazonick criticises their doubts of the inhibiting effect of vertical specialisation (Lazonick 1987). …and they reply by expanding their criticism of his declinist argument (Saxonhouse and Wright 1987). A very useful clarifying review by Mass and Lazonick reworks their position to incorporate most of the points made in the debate (Mass and Lazonick 1990). In Lazonick’s later book, the main source here, he has
account of the development of craft control in the British cotton industry remains a useful demonstration of the underlying logic of the institution.

The origin of the craft control of skills lay in the only partial transformation of the old ‘putting out’, or cottage mode of production, into a more recognisably modern management-controlled form of production. In the boom conditions of the late 18th century, British entrepreneurs wanted to attract skilled workers out of their homes into factories, where their work could be more closely overseen. These 18th handicraft workers were not disciplined for factory work and strongly resisted the organisation of work inside factories, and so to attract them British entrepreneurs were forced to make fundamental concessions over the control of work inside the factories. The compromise was the establishment of internal subcontracting throughout British textile factories (Lazonick 1990,p81).

moved to the institution of craft control of skills as the central institutional explanation for relatively poor, 20th century British technological performance. An excellent primer before entering this debate are the references to these authors in McCloskey’s work on rhetoric and stories in economics and history (McCloskey 1990). For what it is worth I have adopted a compromise position; on cotton, with Saxonhouse and Wright, I cannot see why we should blame British management for making profits by adapting their inherited institutional form in the long period until WW1, when the labour and capital intensive technologies of cotton textile manufacture coexisted. There is a distinct echo here of the apparent paradox of coexistence of substituting technologies discussed in the chapter on competition and innovation. Reference to that chapter would prompt us to examine the nature of the markets served by the old and new cotton textile technologies. Indeed, in the Mass and Lazonick paper it appears that in Japan, the old technology served the home market, the new the export market. Without further evidence from these sources, and with the knowledge that fashion is very important in textile markets, one may surmise that the old labour intensive technology was better adapted to short production runs and rapid changes in textile design for the home market. The new technology concentrated on export markets because it needed long production runs in staple cloths to obtain its economic advantages – perhaps the scale of the home market for such production was too small. If you object to this as conjecture, I would only say that if such conjectures can be made, they are preferable to a belief that ‘British management’ deliberately and irrationally chose to ignore profitable technologies for profitable markets.

After WW2, but not in the textile industry, Lazonick’s argument appears more convincing, as will be discussed above.

21 It is a dangerous business associating forms of production with a series of ascending, progressive steps to modernity. The globally successful Swiss watch industry was organised as a putting-out mode of production until the advent of digital watches in the 1980s (Steinberg 1996).
Internal subcontracting was an incomplete form of owner-control over production that left the skilled worker with control of operations, i.e. of the recruitment and training of workers and of the supervision of the flow of work. From the handicraft workers’ side, the retention of these forms of control over production was in exchange for moving into the more disciplined factory environment and dropping their aspiration to become independent craftsmen.

The subcontracting relationship was reflected in the pay scheme; in spinning, skilled mule spinners were paid piece rates while their unskilled employees were paid time wages. This practice left the skilled workers with every incentive to extract maximum effort from the unskilled workers – their source of income (Lazonick 1990,p80). They therefore retained great incentives to maintain their privileged position with respect to the unskilled that internal subcontracting represented. This skilled elite early organised a powerful craft union to represent their sectional interests to employers. In textiles this elite would successfully preserve the internal subcontracting arrangement into the last stages of decline of the industry in the mid-late 20th century.

It was typical of this privileged worker elite that its union expected to negotiate over any technology that affected their position of power in the internal hierarchy of the firm. They were therefore willing to accept new technology that stripped their role of any remaining skill, provided their position and power was recognised and maintained by their employers. In this way, the craft union came to represent those who controlled internal operations and the flow of work, rather than those directly in possession of artefact-related skills.

Craft control of skills and operations was the widespread means by which the shop floor in nineteenth century Britain had come to be organised. The demand to control the conditions of new technology implementation was therefore also widespread, and even openly stated, as in this quote from documentation of the British boilermakers craft union.

‘When labour saving appliances... are introduced to work which is ours by right, by inheritance and by the fact that our members have served an apprenticeship, that whenever such a machine is introduced to work formerly done by our members, it should be
done by our members’ (circa 1915, quoted in (McKinlay 1991,p105)).

This demand made sense given that the workforce, rather than the employers were responsible for the transmission of skills. An employers’ acceptance of an apprentice meant the firm was willing to legitimate the transfer of craft skills from one worker to another, but direct control of the process was typically left in the hands of a skilled worker. The result was that skilled workers saw other workers, and their own craft union, as the source of the skills which gave them power in the labour market, not their employer. Should new technology render existing skills redundant, the employer had no ability to retrain, since they had no control of training in the first place. Where this institution was prevalent and with the usual search for security of employment on the part of the workforce, it made sense for the skilled elite of workers to demand control of the conditions of implementation of new technology.

Since British apprenticeship was left under the control of craft unions, their prevalent interests, not the employers, shaped this institution. So craft unions had a natural interest in influencing apprenticeship conditions in the interests of existing skilled workers. For example, they tended to restrict the number of trainee entrants to skilled worker status below employers’ needs, for this improved their bargaining position viz. a viz. employers. On the positive side they did have an interest in maintaining the breadth of their training, for the sake of job mobility. It is probable that the worst characteristic was that because workers trained other workers in the workplace, they tended to transfer knowledge of existing practice in a particular firm. As argued by Sidney Pollard, this was adequate enough if existing practice was also industry cutting-edge practice, as it was in Britain for much of the nineteenth century (Pollard 1989). But when a British industry fell behind the cutting edge of some foreign industry, there was no means by which craft-controlled apprenticeship could quickly adopt foreign best practice, and certainly no incentive for the craft union to retrain existing workers – the benefits would appear to entirely accrue to the employers, the costs to the craft union.

A spectacular example of the contrasting efficacy of craft control and internal, company-controlled training is the introduction of welding to ship production in 1920s Britain and Japan. Mitsubishi shipyards instituted a large-scale in-house training programme that spread the technique rapidly through the industry. In the UK the boilermakers’ craft union was allowed
to ‘capture’ the right to transfer welding for the traditional apprenticeship system. With long indenture periods that existed partly to control entry to the craft union and no retraining of existing ‘skilled’ workers, the diffusion of welding skills was a decades long process compared to Japan. The Japanese were welding ships for the second world war, but even in the 1950s many UK shipyards were still riveting steel plate (Fukasaku 1991).

The example of welding is one of pure technique transfer, but a more serious and increasingly general problem, as argued by Lazonick and others, was when new, typically capital-intensive and near-continuous process technologies appeared, that for their most efficient exploitation required major disruption, even the outright abolition of existing occupations. How the transition to such technologies was managed had the potential to set management-owner interests hard against those of the craft union.

Some of the most interesting examples of the management of this transition in Britain concern the most skill intensive industries – the shipbuilding, engineering, car and steel industries. They also allow us to broach the question of how relevant variant forms of craft control continue to be in the Anglo-Saxon economies of today.

Managing craft control during the transition to radical new technological forms

Craft control in engineering

By the inter-war years some British employers were becoming aware of the deficiencies of informal apprenticeship and began to make ad hoc and individual attempts to improve it, for example by including compulsory classroom education, on the German model. Gospel and Okayama in their overview of the British employer response argue that large British employers never fully controlled the system of skill transmission and failed to ensure organisational forms that would support standards of apprenticeship training,

'Out of 1573 engineering firms surveyed in an official inquiry in 1925, only 26 had separate "apprentice masters" whose sole duty was to train apprentices and even fewer had special training departments or schools. Only 10% of textile
employers granted day release to apprentices and this was the most generous industry’ (Gospel and Okayama 1991,p24).

In the absence of collective regulation or reform, the informal training system became subject to abuse. Employers increasingly sought to use apprentices as a source of cheap labour during recession, even while during business cycle peaks firms remained unable to overcome shortages of skilled labour. Where they became interested in mechanisation (especially within engineering and ship-building) they attempted to limit the breadth of training for apprentices and to substitute large numbers of such cheap apprentices for the existing skilled workers (McKinlay 1991). According to McKinlay, the Engineering Employers Federation did attempt to coordinate industry-wide reforms of apprenticeship institutions to meet the agreed labour force needs of the industry, but such attempts foundered on the lack of interest of its member firms. Too many firms chose to continue to rely on informal apprenticeship for their skill needs and remained unwilling to back the proposals for collective reform. In this way the inheritance of informal apprenticeship practices undermined what had to be a collective effort of reform.

Lazonick chooses to place the responsibility squarely on British management for allowing the import and persistence of craft control into the most skill intensive industries.

‘The exercise of craft control, even in the absence of craft skills, was a result of the historical willingness of British employers to relinquish what Americans and Germans came to define as the management function’ (Lazonick 1990,p184).

Lazonick further develops the case of engineering as evidence of this British employer tolerance of craft control. Here, the craft union representing shop floor fitters and turners was weaker than in textiles and the employers always defeated its organised strikes. Such victories allowed engineering employers at times to free themselves of their craft union. They were therefore in a position of relative strength when compared with employers in other industries - for example, the employers in the cotton industry were never in a position to challenge that industry’s craft union. Yet engineering employers never reorganised control of the shop floor and preferred to rely on experienced workers, or ‘shop stewards’ to maintain the flow of work (Lazonick 1990,p198).
In answer to Lazonick’s tendency to blame management, one might suggest that he underestimates what was required for an adequate collective response. If we keep the free rider effect and the coercive power of German industrial associations in mind, one can doubt that any voluntary effort at collective reform would have been much of an improvement on the sum of uncoordinated, voluntary and individual reform efforts. Of course, this shifts the explanatory burden on to the question of why the British employers did not seek state-derived coercive powers to support collective reform: not a question addressed in any detail by these sources.

Nevertheless, the form in which craft control persists into the twentieth century to plague the British workplace is in this reliance on shop stewards loyal to their workplace colleagues, rather than on the supervisor loyal to management.

In the case of engineering, a recent study of nine pairs of matched plant of British and Japanese machine tool manufacturers by Whittaker found, against his expectations, a continuing preference for craft control of work on the part of British management (Whittaker 1990). The Japanese, on the other hand, had what Whittaker termed a ‘technical’ approach to managing operations, one that involved a relentless search for operating efficiencies and no respect for custom and practice. One of Whittaker’s illustrative examples of the contrasting approaches was the Japanese willingness to allow CNC machines to run unmanned and the British preference for the allocation of a skilled machinist to their CNC machines. This appears as something of an indictment: it can be said in defence of the British (and somewhat ironically) that their firms were in steep decline while the Japanese were rapidly expanding. The Japanese would have had every incentive to save on skilled labour, the British would have a skilled labour surplus, with insufficient work. this is better seen as suggestive, rather than definitive evidence of a continuing problem with craft control in Britain in the small firm skill intensive sector.

Craft control in the car industry

As Lazonick explains it, such was the preference on the part of British owner-employers for relying on craft control of the shop floor that they imported it into the new industries, such as car manufacture. Lazonick points out that this occurred in Britain in the 1920s, a time when US
companies were conducting successful experiments with the organisational innovation of the personnel department as a means of winning worker loyalty and cooperation. It was also at a time when an example of how to use close supervision by foremen loyal to the firm was available in the example of Ford’s 1911 assembly plant in Britain (Lazonick 1990, p201).

Once craft control had been imported into the British car industry, it endured to modern times and into the declining years of that industry. The role of the front line supervisor was - and is - a critical one. This individual could represent management and its interests on and to the shop floor, but if power was allowed to shift to the shop floor, then this function could be considered discharged by the shop steward as worker representative. A vivid confirmation of Lazonick’s indictment of British management is presented by Wickens, the personnel manager for Nissan when the company built its first European car plant in Sunderland, Britain, in the late 1980s (Wickens 1987).

Wickens describes the process by which the supervisory function in the British car industry had been degraded over time. The familiar pattern was that supervisors tended to have been promoted from the shop floor on the basis of on-the-job performance, but had few formal qualifications. Their generally poor performance as supervisors had generated a short run adaptive response by senior management. This involved the progressive stripping of management responsibilities from the supervisor and their allocation to professional specialists: so personnel specialists dealt with industrial relations; specialist layout and maintenance engineers had control over those functions; shop stewards controlled work organisation and the division of labour. Over time, this stripping of responsibility had helped to lose the supervisors their pay differential over shop floor workers. The result was a decline in the respect given to supervisors, a decline in the authority of production managers within the firm and the inability of these managerial positions to attract capable people.

The description of degradation of the supervisory role makes Nissan’s response intelligible. For its new plant, the company first doubled prevailing line manager pay to the level of a professional engineer. They then widened the supervisor’s responsibilities to include: quality control; hiring of workers; maintenance; work area layout; design of cost control system and work scheduling. In other words, all the basic operations management functions were returned to this pivotal management function. In the recruitment process itself it is significant that rather than using the
tired British practice of appointing those with ‘experience’, Nissan used sophisticated psychological and personality tests to select people that could creatively discharge their responsibilities (Wickens 1987). When Nissan eventually hired 22 new line managers, only 6 would have the dubious privilege of having had management experience in the British-owned car industry. In this way, Nissan restored a functioning management hierarchy - a precondition for the restoration of systematic innovation on the shop floor.

Lazonick cites one piece of evidence that suggests that this picture of a degraded production supervisory function, with its implication of loss of management control over the shop floor, had become representative of a large swathe of British industry by the late 1970s. At this time, around 40% of British supervisors had joined trade unions, an act that signified their insecurity in employment (Child and Partridge 1982,p195). Child and Partridge draw the familiar scenario of senior British management indifference to supervisor pay and conditions that had been allowed to deteriorate to the level of shop floor workers. At the same time senior British management had continued to try to hold their unsupported supervisors responsible for the flow of work on the shop floor. In other words, arbitrary and indifferent senior management treatment had driven British supervisors out of a dysfunctional management hierarchy and into unionisation (Child and Partridge 1982,p195).

**The conditions for the elimination of craft control in large companies - the steel industry**

Some of the conditions necessary for British industries to successfully manage the legacy of craft control can be found in Owen’s brief summary of the development and management of the British steel industry (Owen 1999,p115-150). The classic British industrial inheritance from the nineteenth century pertained in steel: a large number of fiercely independent, competing owners and a tradition of devolving the management and allocation of work to the shop floor. The difficulties of reform under a fragmented ownership structure are illustrated in the second period of private ownership from 1957-1967, when the efforts of one privately-owned firm to tackle the over-manning of its plant foundered because of the excessively complex union negotiations (Owen 1999,p135).

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22 Lazonick cites this figure from Child and Partridge, who take a 1979 figure from the Institute of Supervisory Management (Child and Partridge 1982,p11).
While the industry was privately owned, and despite voluntary mechanisms set up to encourage merger and rationalisation, ‘by the time of the Second World War the industry was only slightly less fragmented than it had been twenty years earlier’ (Owen 1999,p121). The industry would be nationalised, then denationalised, not once, but twice. With regards to craft control, rather than either form of ownership having clear intrinsic advantages, what mattered was first, whether under that form of ownership management had acquired a theoretic power to reorganise the industry, and second whether and how they chose to exercise that power.

The theoretic power to reorganise was certainly acquired in the second period of nationalisation beginning in 1967. The problem appears clear enough: in the year 1975 and measured in tonnes of crude steel per man year, British Steel had only 23.5% the productivity of the Japanese leader, Nippon Steel (Owen 1999,p136). Owen writes that the large number of obsolescent plant explained most of this gap, but ‘the five largest works were also seriously overmanned’ (Owen 1999,p136). Yet when British Steel tried to negotiate on over manning with national unions, it found it had to renegotiate at plant level, only to make little progress. This might not be surprising, given the eighteen unions with which it had to negotiate (the number in 1979), each jealous of the conditions of work won by its rivals, and given that it was at the individual plant level that the power lay under the craft control of work (Owen 1999,p137). So as regards labour relations in these early years of nationalisation, if management had acquired the theoretic power to act, they had yet to find a way to practically apply it.

The last conciliatory effort by management was the attempt to interest the steel unions in radical plans for industrial democracy; an attempt to win union backing for the necessary plant changes (Owen 1999,p139). It failed for lack of union interest. The increased pressure to reduce financial losses from the 1979 Conservative government led to a three month strike that ended with the unions defeated and the highest annual loss in British Steel’s history, of £1.8bn (Owen 1999,p144). With power demonstrably

23 The situation for British Steel management was complicated over time by ad hoc government interventions. Two of the worst included: a conservative government decision to split a projected, economic plant into two plants to be sited to meet regional employment targets; and a Labour government decision to cancel some of British Steel’s desired obsolescent plant closures.
shifted towards management and with £4.5bn pounds of continuing state support between 1980 and 1985 (Owen 1999,p144) management were able to press ahead with change at the plant level: they made multi-union agreements that reduced inter-union disputes; they began to dissolve the strict demarcation of work between rival ‘trades’; they began to introduce a version of the multifunction team, for both maintenance and production (Owen 1999,p145). By 1987 an industry report found British Steel to have the lowest costs per tonne of steel produced of any of the world’s major steel makers (Owen 1999,p146). It was privatised in 1988 as a profitable concern. It continued the ‘normal’ search for productivity and quality improvements in private ownership so that by the end of the 1990s, France, Germany and Britain each had ‘a major national steel company of roughly comparable size and roughly comparable levels of productivity’ (Owen 1999,p148).

Owen concludes on steel that, ‘if nationalisation had not taken place and the companies had been obliged to compete freely, it is likely that market forces would have brought about the necessary reorganisation of the industry’ (Owen 1999,p149). For Owen it is the government that bears the major responsibility for the delay to the modernisation of the industry. This is rather strange, since by the evidence he assembles, when it had the chance, the private sector failed to manage either industrial restructuring or the elimination of craft control. Why did not ‘market forces’ work then?

The billions of state support in the 1980s were in part necessary to cover costs not incurred in earlier years. One may nevertheless suspect that the private sector would have baulked at the prospect of industrial action and the associated billions of heavy losses, necessary though these were if management control were to be reasserted over the shop floor. In this scenario, it might have proved economically rational to prefer industrial peace and continued craft control of the shop floor, at the price of lower operational efficiency and lower prospective returns on any new plant – as it had so proved in earlier decades. Of course we cannot know with certainty – we are playing the game of ‘What if?’ It seems to me at least as reasonable a scenario to the one preferred by Owen.

The larger significance of this example is that if it took a stream of blank cheques from the state and over 20 years from the inception of the capital-intensive technologies of the 1960s to reassert management control over the shop floor, what chance in industries such as general engineering?
Concluding remarks on British craft control and the German and Japanese institutional means to the end of shop floor control.

This short review of the British problem of craft control of the shop floor is interesting in its own right, yet it also deepens our understanding of the advantages of the German and Japanese institutional means to the end of shop floor control. There are also questions, such as whether the craft control of work will continue to persist in Britain, whose answers depend on our understanding of how the German and Japanese institutions support employer control of the shop floor.

To recap: the institutions of reformed German apprenticeship and the keiretsu-supported Japanese employment system are quite distinct in form. Yet they are certainly comparable in terms of their effects on the management of shop floor operations.

Central to the control of the shop floor is employer control of work and especially skilled work. The Japanese means to this end is the institution of lifetime employment. The market power of keiretsu organisation enables the elite Japanese industrial firms to extend security to the blue-collar workforce and remove the deterrent of a free rider effect on training investments. The German means to this end is through the coercive collective power possessed by employer associations over the apprenticeship institution in their respective economic areas. Employers collectively control the supply and content of broad and general skill qualifications and in both countries there is a structured promotion route from the shop floor into the management hierarchy. A plentiful supply of general skills enables many German firms to establish their own version of the Japanese core-periphery model of employment; this is the arrangement where there exists a core of particularly valued and relatively protected skilled workers at the same time as a periphery of less secure, less valued workers (Sengenberger 1992,p248).

As viewed from Germany and Japan, the British institution of craft control is quite clearly linked to the employers’ failure to take control of skills; so for example, the German industrial sociologist Sengenberger,

"[In West Germany] there is almost a complete absence of the Anglo-Saxon type of craft organisation or (competitive) craft
unionism using occupational jurisdictions or demarcation lines as means of job control (Sengenberger 1992, p248).

This pinpoints arbitrary on-the-job ‘experience’ and reward as the source of the craft control problem. Because a German skilled worker has a broad range of expertise, they are unlikely to be threatened by a change in technology that makes a particular task obsolete. A British worker whose skill, status and pay pertain only to a narrow task is more likely to feel threatened by technological task obsolescence. Even if this does not threaten him with redundancy, it will threaten task-dependent pay and status and so complicate the management task of worker reallocation to other tasks in the organisation. Such ‘demarcation disputes’ were a hallmark of the British car industry’s labour relations problems in the 1960s and 1970s.

Now we are in a position to interpret the steep decline in the number of registered British apprentices that contrasts so markedly with Germany. Apprenticeship in Britain has declined steadily, from over 200 000 apprentices in the late 1960s to less than 90 000 in the late 1980s (McCormick 1991). It should now be evident that the British institution is so unlike the German that far from this decline constituting a disaster, it might not have been altogether bad if a more modern institution had been introduced to replace it. Indeed, the British state made increasingly vigorous and expensive interventions into institutions of vocational training from the 1980s onwards. How and why the British state managed its attempted reforms of vocational training is a topic for another paper.

It is time to think again about the significance of the theoretical construct of the free rider effect, incomplete as it is usually posited. It has already been pointed out that is usually imagined only to apply to some established set of skills in the market economy, and that where new, highly valuable general skills are evolving around a new technology, such as robotics, any deterrent effect on employers’ incentives to train can be expected to be greater.

Prais has argued that as an economy grows and local labour markets merge to become a national market, it is then that the free rider effect on general skill training can be expected to become a problem
(Prais 1995,pxiii). This is a useful reminder that where labour markets are confined to local industrial regions, by geography or poor transport links, there is what can be called a natural constraint on the operation of the free rider effect: for example, firms in small regions can engage in tit-for-tat discipline on known training cheats.

To continue with Prais’ summary of the early stages of the evolution of the free rider effect: as local, natural constraints are overcome and national markets are created, poaching behaviour begins and a tendency to reduce general skill training also begins to manifest itself. There is at first a reservoir of historically generated skills that buffers the effects of lower rates of training on internal organisation of operations, but with a long time lag of the order of a generation, the pool of available general skills decreases and the temptation to poach skills and the deterrent effect on training escalate together - a form of positive feedback, this time of a progressively damaging kind.

This further extends our introduction of a dynamic aspect into the free rider effect when innovation is considered. The question that is opened now is whether, and how the effect might continue to evolve; more specifically, whether the persistence of craft control in Britain is not merely an idiosyncratic hang over from that country’s idiosyncratic past, but something akin to the ‘end state’ of evolution of the free rider effect that threatens to occur in any country where the preventative institutions are absent. The problems of the free rider effect would then consist, not merely of insufficiency of supply of skills, but of the development of a worker interest that is pitted against a management interest in technological change. In this book, the question must remain an interesting and plausible possibility, for there is no space to work through the detailed arguments for and against.

At the heart of a deeper investigation would remain the question why craft control persisted in so many skill-intensive British industries into the 20th century. The problem has tempted Lazonick to place blame squarely on British management, viz. the second sentence of the quote below:
At the root of British decline was the persistence well into the 20thc of the very organisational structures that had brought Britain to dominance in the 19thc. Fundamentally, Britain’s problem was not "bloody-minded workers" but "narrow minded managers" (Lazonick 1990, p182)

My view is that when he blames British management, Lazonick tends to underestimate the difficulty of transforming these organisational structures. The problem of expunging craft control wholesale was one that required some form of coercive collective action to end the ‘freedom’ of a segment of the private sector to poach other firms’ skilled labour. In their different ways, both German and Japanese institutions have this coercive element and it is of course available to private sector firms that have a high degree of market control by reason of their size. Yet to first establish this coercive power would require the involvement of the state, as it did in Germany and Japan – and as it did in Britain in the instance of British Steel. The problem of collective action for the British would have been how an enlightened segment of the private sector might win state support for a coercive reform of training that would naturally be opposed by the, perhaps prosperous and numerous, but backward segment of the private sector.

If we wish to blame some agent for the persistence of craft control in Britain, the lack of involvement of the British state in a general reform of vocational training would seem to be as much a candidate for blame as ‘British management’. The British state has usually required unanimity amongst the private sector community before it has been willing to act coercively. There is good evidence that the predominant style of state intervention in the private sector in Britain has hindered the resolution of the British problem with training (see for example (Jordan 1992; Wolf 2002)).

The Practice of Management and the Divorce Between Management and Technological Education

This paper has been about the ways in which innovative management has been enhanced by structured shop floor experience combined with different forms of technical education. A marked feature of the German and Japanese institutions was the existence of a shop floor promotion route into the management hierarchy. Associated with this was an understanding
that management implied knowledge of technology, especially of the operations function. This section explores the significance of the widespread belief in the Anglo-Saxon world and increasingly in other industrialised countries that management should be understood as divorced from technical and operational knowledge.

Clues that this matters abound, in the history and contemporary debate of both engineering education and management education. In Britain the idea that if engineers are to be a source of managers then engineering curricula should include management teaching is an obvious one and an old one. Divall found that a consequence of the post war attempt to make engineering curricula more scientific was the end of hesitant steps made in the 1920s to introduce management education into engineering curricula (Divall 1990,p94). These experiments can be understood as a continuation of the logic of engineering curriculum development of those years, that an engineering graduate should be a useful technology manager, not simply a specialist artefact designer. However, with the adoption of an engineering science curriculum, management education would be left to develop in the distinct institution of the business school. The Finniston report of the early 1980s found this unsatisfactory and once again urged the inclusion of management teaching in engineering curricula. Given the numbers of scientists and technologists that take MBA degrees, it is possible that had engineering education continued in the path begun in the 1920s, this split between engineering and business education institutions would not have occurred to the extent that it did.

One of the consequences of the creation of distinct educational institutions for the teaching of technical and management subjects has been the gradual growth of an academic interest group that propagates a context and technology-free concept of management. As an engineer and a management academic, Armstrong calls those that hold such views the ‘management education movement’ (MEM). The MEM typically supports the teaching of a standard mix of management subjects including: business strategy; marketing; financial control and behavioural science (Armstrong 1992). Since this mix is free of technological context it can be claimed to be perfectly general in its relevance to practice, a position that maximises the potential market for such courses. According to Armstrong, the effect on students, particularly those who take lower level management courses such as undergraduate degrees and who therefore possess no operational experience, is to propagate a peculiarly British view of management, a view that management is,
something quite distinct from technical expertise; which, indeed in its more virulent versions, actually regards technical expertise as a disqualification for managerial positions’ (Armstrong 1992,p42).

It is indeed common to encounter the idea that technical and management expertise are distinct in Britain. Not only formal education institutions propagate the idea: the phenomenon of craft control implies that operations and technology are identified with blue-collar workers rather than with the practice of management. There is empirical evidence that the split matters, and is embodied in other areas of management practice. Lam’s comparison of the work organisation of 60 Japanese and 55 British R&D engineers in large electronics firms found a severe split between managerial and technical careers in the British firms and concluded that the,

‘...mechanistically structured and functionally segmented organization systems observed in the British firms have contributed to a vertical polarization between technical and managerial roles, inhibited knowledge sharing and led to the gross under-utilization of engineers in product development and innovation’ (Lam 1996,p206)

So the institutional polarisation of engineering and management education is mirrored in the polarised organisation of the work of engineers and management in these examples. It is mirrored again in the polarised organisation of management and skilled technical workers on the British shop floor.

A paradoxical form of evidence that the split matters comes from the efforts that technologically expert individuals make to bridge the educational gap through the acquisition of an MBA. When research was last conducted into the background of UK MBA students it was found that 31% of students had an ‘engineering background’ from civil, structural, mechanical, electrical, chemical or IT engineering, while 19% had a science or maths background. These two categories of MBA student are

24 These figures were obtained through personal communication with Peter Calladine of the Association of MBAs, (AMBA) London. The report from which these figures
the first and second largest and their prominence does indeed suggest that the MBA has a major role in broadening the formal knowledge base of those who have technical and scientific qualifications. Again paradoxically, this function may even be the MBA’s major contribution to management practice and best defence against recurrent criticism of the stand-alone and formal model of business education that it represents.

Evidence that this criticism is becoming sharper and more systematic in the US is the launch in 2002 of a new journal in ‘Learning and Education’ by the US Academy of Management. Many of the criticisms of the business school status quo curriculum made in this opening issue rehearse the issues already raised in this paper.

For example, Pfeffer and Wong review the evidence on promotional and monetary returns to the acquisition of an MBA and conclude that, ‘there is little evidence that mastery of the knowledge acquired in business schools enhances people’s careers, or that even attaining the MBA credential itself has much effect on graduates’ salaries or career attainment’ (Pfeffer and Fong 2002,p80). There are studies that find a positive correlation between career progression and possession of an MBA, but Pfeffer and Wong argue that those studies apply to the high prestige programmes that screen for the very highest ability applicants. So in this analysis, later career success derives from the personal qualities of the individuals, not the possession of formal MBA business knowledge (Pfeffer and Fong 2002,p82).

What Pfeffer and Wong do not consider is my argument above that the MBA promises to add most value when it broadens existing technological and scientific expertise.

Pfeffer and Wong go on to observe that while business schools tend to teach through formal lectures and case studies, in reality management is a craft within a field of practice (Pfeffer and Fong 2002,p85). They then go on to argue that if the object of the business school MBA is to improve management craft practice, it would be better to borrow the tried and trusted methods of other established vocational training schools, such as on-the-job training and clinical experience.

derive was prepared for AMBA in the early 1990s and titled ‘MBA – Reality and the Myth’.
With the German and Japanese models in mind one might respond, first, that this is quite right, but that the appropriate setting for improving management craft practice is where practice occurs – within the firm, not the classroom. With the German and British models in mind, one would add that classroom education remains an important element of German ‘vocational’ training. A narrow concentration on individual craft skills is unlikely to improve the ability of management to organise skills for firm purposes. It also follows from these models that the formal content of classroom education does matter - it would not be surprising if there were scope for reform of the formal knowledge base of the management education curriculum, so that its content became more relevant to practice. Indeed, this is the gist of Lex Donaldson’s argument in this same issue of the Academy of Management’s Learning and Education Journal (Donaldson 2002).

It is easy to become trapped by the implicit assumption in this kind of discussion that formal structures of ‘education’ have the full responsibility for producing effective individuals. Once again, reference to the German and Japanese models reminds us that the object of institutional arrangements in technical and management education is to enable individuals to combine knowledge to make them practically effective. The striking feature of those countries’ educational models was the way formal and experiential education were integrated in individual careers from technology into management.

Despite the lack of formal structures with this object in the Anglo-Saxon countries, there were substitute means for this end. The exploitation of the MBA by scientists and technologists appears to be one means in these countries for achieving this integrative end – no doubt with weaker effect, for there is no standardisation of experience-in-breadth in these countries. Another example that reinforces that the goal is worthwhile, achievable, even if difficult in these countries is the idiosyncratic ‘education’ of entrepreneurs like Dyson. Dyson studied interior design at London’s Royal School of Art and had no formal engineering, science or management qualifications. If he became more of an engineer than most graduate engineers, it was because he successfully acquired the abilities that would allow him to achieve his ambitions through other means. These abilities included the full range of technological competences, from engineering and product design to finance, marketing, sales and management, but acquired through an eclectic range of formal Royal Society of Art courses,
mentors and project experience (Dyson and Coren 1997, p42). Entrepreneurs like Dyson show what is possible without the major engineering and management institutions if an individual is motivated to take responsibility for combining their educational and practical experiences. The abilities he lists are further confirmation of what makes an effective technology manager, engineer, or entrepreneur. His individualistic means of acquiring them suggests once again, that such people will more likely be produced in the countries that have systematised their institutions of education and work experience.

Conclusions

A skill is an unremarkable element of knowledge. After immersion in the issues of how they should be, and how they actually are organised for effective technology transfer and innovation, it is worth remembering that human beings evolved to be good at the acquisition, practice and development of skills; we are bipedal, with long arms free to manipulate, and with hands and opposable thumbs for precision in the manipulation of the things of this world. We all acquire and discard skills and do so throughout our lives.

Skills and experience are valued as knowledge of ‘how to do’, but as such the possession of skill is intrinsically difficult to judge without personal knowledge of the relevant individual’s practice. Then we have the free rider effect. The problems of the production, maintenance and alteration of a useful stock of skills in the market economy appear primarily organisational, not ones of individual acquisition. In summary, the German and Japanese institutions discussed here are: means of eliminating any free rider effect; of establishing confidence that a class of individuals possess a certain standard and breadth of skill; means of providing selection and promotion routes for the most able skilled individuals into the management hierarchy. Last but not least, they provide the means to avoid the sectional interest problems that derive from the craft control of work.

Economists would probably describe as ‘market failure’ the inability of an unreformed market economy to provide a sufficient skill base for the diverse needs of a modern technological economy and society. Market failure simply means that the market outcome is less good than the best attainable outcome. The idea is useful if, from an Anglo-Saxon standpoint, one is tempted to object to the drastic and coercive institutional changes wrought in Germany and Japan that they are a curtailment of that
decentralised decision making that is the most valuable feature of the market economy. If one acknowledges the dynamic management of technology as socially valuable then it is up to the critics to find some other way of repairing this market failure than the German or Japanese solutions. If one understands the array of operational strategies that were reviewed in this paper as obtainable only with some such constraint on ‘free’ market behaviour, one would have to remember that these behaviours themselves represent increased degrees of freedom of action for the decentralised decision-makers within the market economy. The exercise of free choice requires not only a legally guaranteed freedom of action, but also the ability to act.

The German and Japanese coercive solutions were developed when those countries committed themselves fully to the problem of technology transfer as a means of economic catch up with their leading, political rival states. Britain represents the interesting case where technological and economic leadership has been gradually lost over many decades, even as the country has become, like the other industrial countries, ever materially richer. So Britain has incrementally acquired an increasingly acute technology transfer problem. This is arguably more important a problem for that country than any need to promote ‘innovation’ – the current obsession of the British government. Nevertheless, the British state has turned its attention to the problem of institutional reform of vocational training in recent decades, albeit with poor results so far (Wolf 2002).