Lean Production and the Toyota Production System – Or, the Case of the Forgotten Production Concepts

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Advocates and critics alike have accepted 'lean' images of the Toyota production system. But certain production concepts that are integral to Toyota production system theory and practice actually impede 'leanness'. The most important of these are the concepts of *heijunka*, or levelled ('balanced') production, and *muri*, or waste from overstressing machines and personnel. Actual Toyota production systems exist as a compromise between these concepts and the pursuit of leanness via *kaizen*. The compromise between these contrasting tendencies is influenced by the ability of unions and other aspects of industrial relations regulation to counter practices such as short-notice overtime and 'management by stress'.

Introduction

From the late 1980s, debate around work organization converged on the concept of 'lean production' which was, according to its advocates, a 'post-Fordist' system of work that is at once supremely efficient and yet 'humane', even democratic (Kenney and Florida, 1988: 122; Adler, 1993; Mathews, 1991: 9, 21; 1988: 20, 23). However, critical research found that, rather than being liberating, lean production can actually intensify work to the point where worker stress becomes a serious problem, because it generates constant improvements (*kaizen*) by applying stress and fixing the breakdowns that result. It thus attracted such descriptions as 'management by stress', 'management by blame', 'management by fear' (Parker and Slaughter, 1988; Sewell and Wilkinson, 1992; Dohse et al., 1985).

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Ironically, at the same time as lean production was becoming the latest fad in the West, there was an urgent debate in Japan about the quality of work (Berggren, 1995; Benders, 1996). The phenomenon of *karoshi* – death from overwork – was seen as evidence of the way the pursuit of 'leanness' stressed workers, causing highly deleterious social consequences (NDCVK, 1991; Kato, 1994; Nishiyama and Johnson, 1997). The normally pliant Japan Auto Workers' Union produced a report critical of working conditions in the national vehicle assembly industry (Sandberg, 1995: 23). As a result of this and other factors, some key Japanese auto producers retreated from 'leanness', and set up exemplary models of work that were interesting hybrids of the Toyota production system and 'humanized' work principles (Benders, 1996; Shimizu, 1995; Berggren, 1995). Critical researchers have also suggested that the way forward for the organization of work might be to combine elements of lean production with principles of 'humanized work' (Berggren, 1992: 16, 232, Ch. 13; Sandberg, 1995: 2). Such combinations are conceivable, and the Japanese experiments question the assumed identity between 'lean production' and the Toyota production system.

This article argues that the focus on 'leanness' by critics and advocates alike has distracted the gaze of researchers from certain 'anti-lean' concepts contained within Toyota production system theory and practice. The article also suggests that the degree of 'leanness' in particular plants is shaped by surrounding institutional frameworks. Management strategy will seek to move down the lean path ('doing more with less'), while conditions in the labour market, industrial relations and the resources of affected unions may limit leanness. The first section surveys the dominant 'lean' image of the Toyota production system. The second section explicates the Toyota production system's 'forgotten production concepts'. The third section explores the mechanisms by which a particular plant's degree of 'leanness' comes to express the balance of forces in the industrial relations system and its political-institutional surrounds. The section also notes how shifts in this balance have driven a certain 'humanizing' of the Toyota production system in Japan, and canvasses the interesting case of Australia, where characteristics of the industrial relations system deflected the test case Toyota Altona plant from paradigmatic 'leanness'.

The Toyota Production System: 'Lean Production' or 'Management-by-Stress'?

The report of the MIT project into the world car industry attributed Japanese economic success to 'lean production' (Womack et al., 1990). This term quickly shaped images of the Toyota production system, for advocates and critics alike. Resonating with athletic imagery, later purveyors of the concept would emphasize 'agile' production, while critics would emphasize the deleterious effects of 'management by stress' and the dangers of corporate anorexia.

The Toyota production system was developed in the post-war period, and owes much to the production engineer Taiichi Ohno, himself a formidable advocate of 'leanness' (see Ohno, 1988: 44–5). By the late 1980s, owing in part to some deft marketing efforts, 'lean production' became the focal point of the debate about work organization, and was portrayed as nothing less than the future of work.

> Lean production is a superior way for humans to make things. It provides better products in wider variety at lower cost. Equally important, it provides more challenging and fulfilling work for employees at every level. . . . It follows that the whole world should adopt lean production, as quickly as possible. (Womack et al., 1990: 225)

Lean production is lean, its advocates argue, because it uses 'less of everything', even as little as half (Womack et al., 1990: 13). While this is certainly an exaggeration (Williams et al., 1992; Unterweger, 1992: 3), the claim that lean production could combine efficiency with quality of work life quickly became widely accepted. 'Lean production' became seen as 'best practice' (e.g. PCEK/T, 1990: Ch. 4; Dertouzos et al., 1989). The principles were transferred to other countries, as Japanese auto and other producers shifted production facilities overseas, where they met a mixed reception.

Many accounts of the Toyota production system accord centrality to the concept of *kaizen* or 'constant improvement' (Womack et al., 1990: 56; Oliver and Wilkinson, 1992: 35; Fucini and Fucini, 1990: 36, Ch. 3). Improvement means the removal of all activities that do not add value, which are defined as waste, or (in Japanese) *muda*. The concept of *muda* can refer to excessive set-up time, excessive inventory and work in progress, defective materials/products

that require rework or repairs, cluttered work areas, overproduction, unnecessary motions, too much quality (overspecification), double handling in conveyance of materials and, above all, idle time (Oliver and Wilkinson, 1992: 26; Monden, 1994: 199–200). Monden (1994: Ch. 13) also refers to such *muda* as *seiri* – or 'dirt', and the removal of *muda* is thus a kind of cleansing (*seiso*). An important catalyst to *kaizen* is 'just-in-time' (JIT) production. Contrasting with allegedly traditional western approaches which accumulate stocks of components, JIT means producing only what is needed, as nearly as possible to when it is needed, and delivering it 'just in time' to be used (Monden, 1994: Ch. 2; Oliver and Wilkinson, 1992: 28).[1] *Kaizen*, 'leanness' and JIT converge on the mythological 'zero-buffer' principle. Buffers permit linked production processes to work at speeds somewhat independent of each other, and therefore enable workers to take short breaks, or to accommodate production irregularities without affecting adjacent production processes. Removing buffers makes visible production imbalances and other problems, prompting operators to fix them (Dohse et al., 1985: 129–30). Thus, the necessary counterpart of JIT production is *heijunka*, or 'levelled production' – a condition in which all parts of the overall production process are synchronized with each other. We presently return to the concept of *heijunka*, which, neglected in the literature, is a focal point of this article.

Kaizen not only seeks to eliminate errors in production, but also to locate their sources (Womack et al., 1990: 56; Ohno, 1988: 17). Workers' 'participation' is crucial, through monitoring and detecting any variations in process or product. Workers also contribute ideas about reorganizing and improving production, and this delivers productivity improvements through incremental innovation (Rosenberg, 1982: 60–6; Sayer, 1986: 53). This provides some basis for the claims that 'lean production' is 'participatory', post-Taylorist and post-Fordist (e.g. Kenney and Florida, 1988: 122; 1989: 137; Womack et al., 1990: 102). But work procedures are closely analysed and written down on standard operating procedure charts, which are displayed in the workplace, and which workers are required to follow closely (Ohno, 1988: 21). Changes to work procedures must be given assent by team leaders, and/or higher management. Standardized work provides the baseline for further improvement, and the charts, which record innovations to the work process, are a mechanism for 'organizational learning' (Adler and Cole, 1993).

The organization 'learns' by appropriating the innovations, sometimes driven by stress, which become standard practice. But the consequence is that workers cannot use their knowledge of the production process to protect themselves against pacing, since the system appropriates such knowledge. The Toyota production system can thus plausibly be portrayed as a solution to the classic problem of management – how to persuade employees to put their knowledge of the production process at the service of management – even where this means increasing their own workload (Dohse et al., 1985: 128). However, critics and advocates alike agree the system has the potential to cause stress.

> Most people . . . will find their jobs more challenging as lean production spreads. And they will certainly be more productive. At the same time they may find their work more stressful, because a key objective of lean production is to push responsibility far down the organizational ladder. Responsibility means freedom to control one's work – a big plus – but also raises anxiety about costly mistakes. (Womack et al., 1990: 14)

Taiichi Ohno, the architect of the Toyota production system, celebrates the role of stress. He once candidly described the thinking at the heart of his system in an interview.[2]

> If I found a job being done efficiently, I'd say try doing it with half the number of men [*sic*], and after a time, when they had done that, I'd say OK, half the number again.

Ohno described his 'philosophy' in these colourful words:

> There is an old Japanese saying 'the last fart of the ferret'. When a ferret is cornered and about to die, it will let out a terrible smell to repel its attacker. Now that's real nous, and it's the same with human beings. When they're under so much pressure that they feel it's a matter of life or death, they will come up with all kinds of ingenuity.

Critics too seek to capture the workings of the Toyota production system in the concept of 'management by stress'. As Slaughter puts it 'the management by stress system stretches the whole production system – workers, the supplier network, managers – like a rubber band to the point of breaking' (Slaughter, 1990: 10). Applying stress causes the system to break down, identifying sites where the production process can be redesigned, and improvements won (also see Dohse et al., 1985: 127–30). Reducing inventories keeps

up the pressure for innovation, by denying the buffers that can provide some shelter from the pace of the line.

> *Kaizen* strips away layer after layer of redundant manpower, material and motions until a plant is left with the barest minimum of resources needed to satisfy its production requirements. The system tolerates no waste. It leaves virtually no room for errors. (Fucini and Fucini, 1990: 36)

The more resources are removed from the production system, the more fragile it becomes, making worker cooperation essential. Workers comply because of what Monden calls 'social conventions and institutions [that] can be called the social production system' (Monden, 1994: 336). These permit powerful management techniques. Total quality management (TQM) quickly traces problems to their source, be it mechanical or human. Dohse et al. (1985: 130–1) describe how workers having problems keeping up indicate that by pressing a button that illuminates a display. Management aggregates this information to indicate potential for staffing reductions. Sewell and Wilkinson (1992) note how the systems of quality control actually function as systems of *surveillance* and *discipline* (in a Foucauldian sense), promoting competition, humiliation and peer pressure. Workers are organized into teams, collectively responsible for a production area, and able to cover for one another in times of stress. This presupposes broad job descriptions, multi-skilling and cross-training, which effectively make workers *interchangeable*. Peer group pressure is mobilized against workers who 'let the team down' (Barker, 1993). For instance, when absent workers are not replaced, their colleagues have to pick up the slack, and they therefore police their workmates' sick leave.

In Japan, a complex system of payment and reward, subject to considerable managerial discretion, provides a powerful management control system. Firm-wide pay increases do not filter down to individual workers equally. Workers receive a component related to seniority, and another composed of bonuses related to the team's performance. Another component is allocated according to workers' 'merit'. Thus a wage rise could be from 85 percent to 115 percent of the amount allocated after cross-firm, seniority and team components have been allocated (Dohse et al., 1985: 139; Berggren, 1992: 132). The key figure allocating the 'merit' component is the frontline supervisor, who may also be the workers' union representative, taking a stint on the shopfloor before moving on to a career in management (Moore, 1987: 144).

Historians of the Japanese labour movement note that the Japanese unions were defeated in the postwar period, and structured into pliant enterprise unions, less able to defend their members against work intensification, and allowing the functions of union representation and managerial supervision to blur (Moore, 1987). The renowned practice of 'lifetime employment' and firm-specific training and career paths make for a lack of inter-firm mobility, in turn reinforced by the strong 'core/periphery' division in the labour market. Thus an employee leaving a long-term career in a core firm risks falling into the periphery of insecure and less well paid employment (Dohse et al., 1985: 133–41; Kumazawa and Yamada, 1989). All in all, 'lean production' contains considerable potential for the degradation of work, precisely because it *is* lean.

The Toyota Production System's Forgotten Production Concepts

As argued earlier, popular renditions of the Toyota production system emphasize the elimination of 'waste', with a tendency to focus on 'idle time'. But at least some forms of waste may be eliminated through more efficient production management, as opposed to work intensification (Monden, 1994: 177). Identification of 'waste' in a broader sense may even aid work 'humanization'. Three Japanese words capture a wider range of 'waste', or its sources, than is usual. Fucini and Fucini (1990: 75–6) make reference to the 'three Evil Ms'– *muda*, *muri and mura*, although no attempt is made to tease out the crucial interrelations between them. *Muri* translates as 'overburden – when workers or machines are pushed beyond their capacity' (Oliver and Wilkinson, 1992: 26), or 'the placing of excessive demands on workers or production equipment' (Fucini and Fucini, 1990: 75–6). This may reduce the production life of both human beings and machines. *Mura* is 'the irregular or inconsistent use of a person or machine' (Fucini and Fucini, 1990: 75), which might result from line imbalance or fluctuations in production pace, and which automatically results in some varieties of *muda*. This is because at least some workers and machines will be working below capacity for some of the time, perhaps while some others at bottlenecks are subjected to excessive stress, while yet others may overproduce. If one part of the production process is working at a low level of capacity utilization, while another is overworked, there is waste from both *mura* and *muri*.

The concept of *heijunka* means 'levelled', 'smoothed' or 'balanced' production, and one of its functions is to counter the kind of imbalance described earlier. Monden (1994: 8) refers to *heijunka* as 'the cornerstone of the Toyota production system'. This article suggests that the concept has been underexplored in the academic literature on the Toyota production system (also see Coleman and Vaghefi, 1994: 31). *Heijunka*, or 'levelled production', is a strategy to meet the demands of the market including fluctuations – while carrying as little work in progress stock as possible. Elimination of work in progress inventory offers savings to the firm in terms of the capital that would have been invested in it, in the space needed to house it, in the workers necessary to count it, in losses due to rust, depreciation and so on (Monden, 1994: 2). The emphasis that Toyota production system literature places on *heijunka* suggests that it may be a more fertile source of productivity gains than simply seeking to eliminate 'idle time'.

Achieving *heijunka* is a difficult task of production management, which poses the problem of balancing losses from down-time against losses from carrying inventory in a situation where multiple products are made on the same line. Systems producing complex manufactures are not infinitely and instantly 'flexible' – that is, able to adjust to changes in demand, or accommodate variations between different models. (The Toyota Corona, for instance, came in S, CS, CSX and Avante models, each with different features, in addition to a choice of sedans or station wagons, with manual or automatic gearboxes.) Production has to be planned in advance – and the difficult task here is to aggregate the atomistic components of demand into a production schedule within the 'flexibility' capacities of existing production technology (especially the ability to quickly change press dies and jigs) while containing work in progress inventory. For instance, a month with high demand at its end but a slack period at the beginning, across a variety of models, could be 'levelled' by allocating an 'averaged' (and projected) demand to each day. The alternative would be to dedicate the line first to one model, then to another. But this would require stockpiling components and finished products of one model or another. Toyota's production engineers developed the 'mixed production system' (also called 'linear', or 'synchronous' production), where various models are produced on the same line on the same day, with quick changeovers. This ensures that all components of the production process are working at a 'synchronized' pace, minimizing buildup

of work in progress inventory and other forms of 'waste', and achieving 'uniform plant loading' (Coleman and Vaghefi, 1994: 31; Park, 1993; Monden, 1994: Ch. 4; Shingo, 1989). Production plans are thus the outcome of complex and exacting calculations, that balance losses and economies from a variety of sources, and allow the reduction of work in progress inventory, productive capacity and lead times to the consumer (Coleman and Vaghefi, 1994: 32).

Heijunka also seeks to 'balance' the workload to be performed to the capacity or capability of the process (machines and operators) to complete that work (Shingo, 1989; cited in Coleman and Vaghefi, 1994: 31). It also seeks to balance workload between adjacent components of the production system, including between workers. As indicated above, imbalanced production procedures give rise to waste (*mura*, and possibly *muri*). Thus, and crucially for this article's argument, a strong tension exists between *kaizen* and *heijunka*, which intensifies as the buffers and work in progress inventory is lowered in quest of productivity increases. First, since *heijunka* presupposes 'balancing' the workload to the capacity of the operators and machines, increasing that workload to drive *kaizen* is antithetical to *heijunka*. Second, an important source of waste (*mura*) is unscheduled fluctuations in daily work volume (Monden, 1994: 64), and these often result from *kaizen* activities driven by 'management by stress'. Levelling is a counter-principle to this disruption. There is, therefore, a trade-off between economies attained through *heijunka* (levelled production) and those gained by removing buffers to drive innovation *(kaizen)*. Since real interlinked production processes will never attain perfect balance, a certain amount of buffer stock is necessary to attain continuity of production. Reducing this can induce instability, and the need to rebalance adjacent production processes. Thus the notions of 'balanced', 'levelled' and 'stabilized' production, and *continuous* production are intertwined.

Toyota production systems, in a context of considerable product variation, reach a balance between *kaizen* activities and *heijunka* – a balance which weighs losses caused by carrying 'excessive' resources against down-time resulting from attempts to remove those resources. The balance is shaped by who is to bear the costs and benefits, and their relative power resources. First, the costs of disruption to the smooth flow of production (*mura*), in particular down-time, caused by pursuing *kaizen,* might be externalized through short-notice and/or unpaid overtime. Monden argues that an essential support for the Toyota production system is *shojinka*,

or 'the adjustment and rescheduling of human resources', and makes special reference to 'early attendance and overtime' (Monden, 1994: 159, 66). Such practices are in effect a large 'buffer' outside normal working time (Berggren, 1992: 52; 1995: 78). This 'buffer' *externalizes* to workers and communities the costs of excessively enthusiastic *kaizen*, with its attendant disruption of production and *mura*. On the other hand, if communities and unions reject short-notice and/or unpaid overtime, the company would be forced to place a higher value on careful production management to achieve quotas, therefore emphasizing *heijunka* over *kaizen* and the quest for leanness.

Second, in compliant industrial relations systems, the costs of *kaizen*- and stress-driven production strategies may be borne directly by workers. The effects of 'speedup'-induced stress on workers (*muri*) may not show up until after work hours, in the form of fatigue, sleep disturbance, digestive malfunction, headaches, injuries and so on. More immediate problems like occupational overuse syndrome may be 'externalized' by dismissal, and hiring another worker. Many such problems may be paid for by the host country's health system, or by the worker in later life. Such strategies depend on a plentiful supply of willing workers to take such jobs, and 'flexible' industrial relations systems. They also depend on a lax occupational health and safety regime, that either lacks legislation mandating safe work practices, or lacks the means of enforcement. To the extent that particular national social settlements and industrial relations systems permit such strategies, companies can be expected to pursue them.

The Political Shaping of the Toyota Production System

This section argues that the choice of management strategy that emphasizes *heijunka* and production continuity, or leanness and *kaizen*, is shaped by the nature of the surrounding social settlement and industrial relations system. If the latter permits (as the preceding section argued), the costs of pursuing *kaizen* and leanness can be externalized. On the other hand, some industrial relations systems reject extremes of 'leanness'. As Turner (1991: passim, 223–5) has argued, unions' and workers' fortunes in the 'new era' are crucially dependent on their ability to shape the course of industrial restructuring and work reorganization. This ability depends, first, on

having an accurate analysis of contending images of work organization and industrial policy and their possible implications for unions and workers, and second, on having the 'power resources' to act out of such an analysis. Such power resources consist of legislation that mandates worker participation in decision-making, and/or 'corporatist' arrangements that enable union influence on public policy – in short, on a favourable position within the industrial relations and political/institutional framework which shapes industrial adjustment. Where both exist, excessively 'lean' versions of the Toyota production system will be rejected, and the converse is true – the absence of these conditions may enable truly 'lean' production. In Japan, through most of the postwar period the balance of social and economic forces has clearly been in favour of the 'lean' version of the Toyota production system. 'Lean' plants are also to be found in the USA and UK, where labour is denied influence. On the other hand, in Japan, the early 1990s saw a certain trend away from 'leanness' and 'management by stress' because of a tightening of the labour market (Benders, 1996; Berggren, 1995). Tight labour markets also drove early experiments with work humanization in Sweden, but lately with rising unemployment and an economic liberal ideological offensive, 'lean' images of work have enjoyed increasing acceptance.

No better example of the systematic externalization of the costs of management by stress exists than the homeland of 'lean production'. Through the mid- to late 1980s, the phenomenon of *karoshi* emerged into Japanese public life. The term was invented in 1982 to refer to the increasing number of deaths, typically from strokes or heart attacks, that were attributed to overwork. The National Defence Council for the Victims of Karoshi (NDCVK), a public advocacy group mainly comprising lawyers seeking redress and compensation for the families of victims, estimated there were 10,000 victims of this condition a year (NDCVK, 1991; see also Nishiyama and Johnson, 1997: 2). While the Japanese government officially denied that *karoshi* existed, even objecting to the use of the term by the ILO, by 1993 nearly half of the Japanese population feared they or an immediate family member might become a victim (Kato, 1994: 2).

The origins of *karoshi* lie in the oil crisis and the 'Nixon shocks' in 1973, which imposed a heavy load on Japanese companies, and caused them to demand greater efforts from their workforces (Kato, 1994: 2). To deal with the oil shocks, Japanese companies emphasized 'stripped down management' (NDCVK, 1991: 98) later

to be celebrated in the West as 'lean production'. This contributed to an increasing incidence of *karoshi*, the causes of which 'range from long working hours, a sudden increase in work load and the added mental pressures of expanded responsibilities and production quotas' (NDCVK, 1991: 99). These are precisely the working conditions to be found in excessively 'lean' workplaces which, as we have seen, run on low levels of staffing, with problems that arise during the day fixed by a seemingly endless overtime buffer at day's end. International comparative statistics put the hours worked by Japanese far in excess of other countries (except Korea), at least until the 1990 recession cut them back (NDCVK, 1991; Ross et al., 1998: 347). Furthermore, the widespread practice of unpaid overtime and the aggregation of hours across part-time workers systematically understated hours worked by many Japanese. Of the number of cases reported in a Tokyo Hotline, the majority had been working in excess of 70 hours per week in stressful conditions (NDCVK, 1991: 99). To compound the situation, Japanese workers are allocated far fewer vacation days than their international counterparts, and do not take all of the days owing to them (NDCVK, 1991: v).

The Japanese employer body Keidanren reported in a major survey that 88 percent of employers regularly use overtime (Kato, 1994: 2). This is because of the low overtime premium rates in Japan – 25 percent of the base wage, which itself is only a portion of the total wage (as the account in the second section of this article demonstrated), making the cost of hiring new employees greater than working existing employees on overtime (NDCVK, 1991: 87). Furthermore, the number of hours worked by employees is only weakly regulated in Japan, as state regulations are interpreted flexibly, and the onus for overtime regulation is placed on the company union or a 'collective representative'. Thus, most collective agreements contain a clause effectively giving management the right to demand short-notice overtime in a wide range of circumstances. In 1991 a long-running court battle over the celebrated case of Mr Tanaka – a Hitachi worker sacked for refusing overtime in 1967 – ended, with a determination by the Supreme Court that effectively reinforced managerial prerogatives in this area (see Joint Committee of Trade Unions Supporting Mr Tanaka's Trial, 1989).[3] The bursting of the bubble boom in 1990 caused Japanese companies to cut back on excessive overtime, thus somewhat defusing the issue (Berggren, 1995: 64). However, the case of *karoshi*

underscores vividly how a 'flexible' industrial relations system permits the use of overtime to externalize the costs of 'leanness' on to the surrounding society.

The literature on the transplantation of Japanese production techniques contains many examples of pliant industrial relations systems allowing degrees of leanness that impose costs on workers and the surrounding community. As one example, the study by Fucini and Fucini (1990) of the Mazda plant at Flat Rock, Michigan, is replete with instances of leanness run riot. The company chose 3500 applicants from a pool of 96,500, and maintained a steady supply of 'flexible' labour (Fucini and Fucini, 1990: 1). As the plant got underway, and production volumes rose, production strategies increasingly emphasized 'leanness' through understaffing (Fucini and Fucini, 1990: 147). Overtime was compulsory and workers were notified late, and this became a major point of contention (Fucini and Fucini, 1990: 114, 145). Taking vacations was discouraged (Fucini and Fucini, 1990: 155). There was a high and increasing incidence of repetitive strain injury due to the persistent and high production demands. There were few less demanding jobs for older workers or for workers on 'light duties' due to injury. Supervisors pressured workers to return to work before they were ready, in some cases aggravating the original injury, and in others prompting the worker to refuse, leading to dismissal (Fucini and Fucini, 1990: 175–91). Unlike most transplants in the USA, the Mazda Flat Rock plant was unionized (as the result of it being a joint venture with Ford, the domestic operations of which had to accommodate the United Auto Workers) but the union adopted a compliant stance, perhaps showing particular 'flexibility' on the issue of overtime. (The outcome for the union was increasing worker discontent, and, ultimately, the development of a breakaway faction.) The extremes of leanness were permitted by the way the industrial relations system did not support workers' meaningful participation in decisions of work design. Such 'participation' was limited to *kaizen* activities, on terms controlled by management. The union's lack of power resources, and its accommodating stance with management, left workers with no institutional support to resist work intensification and excessive stress-driven *kaizen*.

On the other hand, well-known work organization experiments and traditions in Europe and Scandinavia embodied somewhat opposite calculations and conditions. Jurgens (1991) has identified

a 'European model' of work, which contrasts with central principles of the Toyota production system. First, work organization should favour long-cycle jobs with higher degrees of skill, autonomy and discretion over short-cycle assembly line work. Second, notions of professionalism and skill are underpinned by public, not firm-level, skill formation and recognition infrastructure. And third, the 'European model' of work rejects Japanese-style 'team work' in favour of 'group work', where teams have more autonomy. The position of the team leader is more accountable to team members, by rotation or election. Fourth, adequate levels of buffer stocks protect against pacing (Jurgens, 1991: 245; Turner, 1991). While the success in terms of implementation is limited, the struggle over work reorganization in Europe can plausibly be portrayed as a clash between this model and the principles that underlie 'lean production'.

The well-known Swedish experiments in work organization reflected certain aspects of the Swedish social settlement of the 1970s and 1980s – tight labour markets, social democratic incumbency, influential unions and solidaristic wages which prevented employers compensating poor working conditions with extra pay. Although the initial experiments on work humanization were employer initiatives (Cole, 1989) the unions were able to influence them towards a more congenial form in certain areas. The 1970s saw unions' influence via 'corporatist' arrangements bear fruit in the form of 'codetermination' legislation that strengthened the ability of unions to influence work reorganization at shopfloor level (Turner, 1991).

Although the balance of forces in the Swedish social settlement that permitted such experiments is by now a fact of history, their ingredients are worth mentioning as counter-poles to 'lean production'. First, there is the oft-mentioned 'Scandinavian' emphasis on quality of work life, which favours 'buffers'.

> Scandinavian respect for the workers' quality of life requires that the worker have the ability to work quickly for a few minutes in order to take a small personal break without stopping the line. (Klein, 1989: 65)

Attempts to make work life more 'humanized' reached their apotheosis at the Volvo Uddevalla factory, which eschewed the assembly line in favour of dock assembly, in which teams of workers assembled whole cars in very long work cycles (Sandberg, 1995). But as is also well known, those union power resources were

considerably wound back in the 1990s. Also, it seems, analysis of the implications of 'lean production' was lacking to the point where 'lean production' would acquire considerable legitimacy, complete with a shift to individualized payment systems, albeit under the guise of 'solidaristic work' (Kjellberg, 1992; Mahon, 1994).

This thesis of how the prominence given to 'leanness' or *heijunka* depends on the balance of forces in the industrial relations/political arena is also supported by relatively recent developments in Japan's automobile assembly industry. From the late 1980s, the Japan Auto Workers' Federation of Unions ran a public campaign against the conditions of work in the auto industry, which it characterized as demanding, dirty and dangerous (Joint Committee of Trade Unions, 1989). It issued a public report criticizing the industry in 1992 (JAW, 1992; Berggren, 1995: 75), and suggested that the working conditions might be improved if managers in the industry gave more attention to the concept of *muri*, and less to the more narrow concept of *muda* (Sandberg, 1995: 23). During the 'bubble boom' period, from 1986 to 1988, tightness in the labour market opened more job opportunities for workers outside the auto industry, leading to labour shortages (Benders, 1996: 14). Part of the employers' response was to undertake work humanization. In one of the ironies of history, this rejection of leaness proceeded just as the West's fascination with the concept grew (Sandberg, 1995; Berggren, 1995: 76; Shimuzu, 1995; Benders, 1996: 11).

The experiments in Japan (specifically Toyota's Tahara and Kyushu plants) moved away from leanness – but within constraints. Most importantly, the practice of short-notice overtime was not available, since work shifts were 'back to back', and this removed the time buffer at the end of the day (Berggren, 1995: 78). Their adherence to JIT was limited by their remote location (Sandberg, 1995: 22; Benders, 1996: 15). They allowed greater emphasis on 'internal' buffers, and the Toyota plant at Kyushu had not one moving assembly line, but a series of 'mini lines' that were linked by buffers (Shimuzu, 1995: 399; Benders, 1996: 18). The lines could be stopped and started independently of each other, thus minimizing losses from down-time, and alleviating the stress that comes from halting the whole plant's production. They made significant changes to the *satei* system, by lowering the proportion of payment that is determined by the individual evaluation, and in some cases removing the productivity-linked component (Shimuzu, 1995: 395–6; Benders, 1996: 21). They made numerous ergonomic

improvements, to lessen the risk of injury (Shimuzu, 1995: 397, passim). It remains to be seen if these plants become more typical of auto production in Japan, but they do illustrate that the Toyota production system is capable of considerable social shaping in an 'anti-lean' direction. On the other hand, the experiments also reveal some of the limits of that shaping. Most notably, although some of the experiments shifted away from automation, at least in trim and final assembly, the basic work process remained essentially unchanged. In particular, there was no lengthening of work cycles, and the moving assembly line remained (Sandberg, 1995: 22).

The case of Australia is interesting but more complicated. It is tempting to see the union movement in Australia in the 1980s and early 1990s as having considerable power resources with which to shape the course of work reorganization and industrial adjustment, and this indeed was the interpretation of many commentators (e.g. Kyloh, 1994; Archer, 1992). However, there is considerable evidence of work intensification in a range of surveys, some of them conducted by government departments (DIR, 1995, 1996), some by independent research organizations (ACIRRT, 1998). Union density has fallen, from 51 percent in 1976, to 31.1 percent in 1996 (ABS, 1997), in part because of the failure of unions' 'involvement' in restructuring. While unions did indeed hold some influence over work reorganization in Australia, especially from the late 1980s, this influence acquiesced to work reorganization that amounted to work intensification. In the late 1980s the union movement as a whole did not make an accurate assessment of the dangers posed by 'lean production' (Hampson et al., 1994). The influential doctrine of post-Fordism did not properly distinguish models of work taking shape in Sweden, Germany and Japan, since they were all 'post-Fordist' (e.g. Mathews, 1989: 37; Curtain and Mathews, 1990: 73; Botsman, 1989). Important union strategic documents lacked a critical understanding of the Toyota production system's potential for 'leanness', and what made it different from European models of work (e.g. Anon, 1989a: 11–13; ACTU/TDC, 1987: 135, 155–6). The concept of 'lean production', embedded as it was in notions of 'best practice', gained considerable institutional momentum. A government International Best Practice Demonstration Programme was set up to provide funds to firms and workplace change consultants to implement 'best practice' work organization (Hampson et al., 1994; PCEK/T, 1990).

Even so, Australia's industrial relations system in the auto assembly industry did not prove to be fertile soil for at least the *extremes* of 'leanness', despite the fact that Toyota made union assent to 'lean' working arrangements a condition of the investment at their new plant at Altona, Victoria (*Australian Financial Review*, 12 December 1991). First, the actual layout of the plant had some similarities with the Japanese 'post-lean' experimental plants described earlier. Trim and final assembly consisted of several mini-lines separated by buffers, and this permitted each to start and stop independently of the others. The concept of *heijunka* was prominent at the plant, according to management, and this somewhat tempered the pursuit of 'leanness'.[4] Second, extending the principles of JIT to suppliers risked disruption, as many could not meet strict delivery schedules, so a thorough component inventory was kept on the plant premises. Third, the company encountered considerable 'external' constraints as to selection, training and reward, and thus did not have a free hand to fully implement human resource management strategies supportive of 'leanness'. A pre-existing agreement with the main union, the Victorian branch of the Vehicles Division of the Amalgamated Metals and Engineering Union gave priority to employees of the nearby Dandenong and Port Melbourne plants, which were being phased out of auto assembly, thus limiting managerial prerogatives as to recruitment and selection. Although Toyota itself was a registered provider of training, the firm's autonomy in that respect was somewhat limited by requirements that training be in line with national accreditation standards, in particular the Vehicle Industry Certificate (VIC), with a view to transferability of qualifications and the development of career paths (Anon., 1989b, 1989c, 1995). And Australia's award system, which determines a component of wages and working conditions centrally, prevented the implementation of individualized merit pay.[5] Workplace reform and restructured awards had in any case linked pay increments with competency standards and progression up skills ladders, integrated with the VIC (Anon., 1989b, 1989c, 1995). Interestingly, Toyota put in place suggestion schemes that gave cash rewards for useful suggestions, and these to some extent provided a degree of 'functional equivalence' to the *satei* system (interview with human resource manager, Toyota, 9 December 1994), which could encourage individual participation in *kaizen*. Fourth, the union had in 1991 just changed leadership in favour of the Left, which was far more suspicious of 'lean' ideas and the

post-Fordist ideology in which they were set than the Right. Thus the union, while committed to the implementation of 'lean' principles by pre-existing 'structural efficiency' agreements, also sought to impede the full implementation of those principles.

Fifth, the company's ability to schedule short-notice overtime was contested. While the relevant 'Structural Efficiency Agreement' (Anon., 1989b: 18) agreed that 'overtime will be worked on a basis determined by the actual production needs of the enterprise', and the 1995 Workplace Agreement affirmed that 'Toyota reserves the right to assign work in excess of the basic working week' (Anon., 1995: 17), the agreement goes on to state that 'working pattern variations will be discussed with affected employees at least fourteen days prior to the variation being implemented' and limits overtime to 20 hours per calendar month (Anon., 1995: 17, 19). However, the agreement also refers to 'short-notice overtime', which is '*voluntary*'. Even so, 'if employees are *required* to work additional overtime on week days, they will be notified of the actual overtime needed on that day by the beginning of the second relief break. The actual overtime *required* will depend on 'the amount of daily overtime forecast and the production schedule volume which may have been lost due to unforeseen problems' and even 'there may be exceptional circumstances' in which 'shorter notice than that detailed above' is justified (Anon., 1995: 19, emphasis added). Reading between the lines, overtime was a contested issue which was not clearly regulated by the formula of words here. However, and this is the point, nor was it a matter of uncontested managerial prerogative, and thus it could not constitute the endless buffer which could support an emphasis on *kaizen*.

Thus, the Toyota plant at Altona, Australia, hardly conformed to the celebrated 'lean' model, and according to management did not seek 'zero-buffers', but sought to balance the goal of inventory reduction against the advantages to be derived from 'levelled production' (interview with human resource manager, Toyota, 9 December 1994).

Conclusion

Advocates and critics alike of Japanese production methods have neglected important production concepts, the most important of which is *heijunka*. There is a tension between the approach to

production emphasized in the *heijunka* concept, and that implicit in approaches driven by 'leanness' and the quest for *kaizen*. An emphasis on *heijunka* values continuity, balance and the avoidance of down-time – *kaizen* accepts disruption in quest of productivity improvements via innovation. This article has argued that the balance struck between the contending principles of *heijunka* and *kaizen* is shaped by the surrounding social settlement within which the industrial relations system and particular work arrangements are set. Strong, strategically adept unions and a supportive industrial relations system that can impede managerial prerogative will be less likely to allow extremes of 'leanness'. On the other hand, industrial relations systems where unions are excluded, lack power resources and/or are ill informed strategically are more congenial to the extremes of 'leanness'. This distinction may offer a rhetorical strategy for progressives to shape the actual outcomes of work reorganization. It seems that Womack et al. have given a less than comprehensive explication of the Toyota production system, and in so doing emphasized 'leanness' at the expense of the 'forgotten production concepts', in particular *heijunka*, *mura* and *muri*. *The Machine that Changed the World* is thus set within a long managerialist tradition with particular strengths in the USA (see Hayes and Wheelwright, 1984) that seeks to substitute for management's deficiencies in the organization of manufacturing by intensifying work at the expense of the conditions of workers.

Notes

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1. The idea was derived from American supermarkets, when empty shelf space indicates more stock is needed (Ohno, 1988: 25–6; Shingo, 1989: 90).

2. Interview given to the BBC programme *Nippon* (shown on Australia's Special Broadcasting Service, 22 October 1991).

3. The Supreme Court ruling on the Tanaka case is available at http://www/mol.go.jp/bulletin/year/1992/vol31-05/05.

4. The Toyota Australia Workplace Agreement (Anon., 1995: 6) lists 'balanced and levelled production' among key principles of the Toyota production system.

5. This information and much of the following was gleaned from two plant visits in 1993 and 1994, two semi-structured interviews with management and six with union representatives (8–10 December 1993, 9–11 December 1994).

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