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Redefining the Toyota Production System: the European side of the story

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Trapped into the sterile opposition between the empowerment and the management by stress approaches, the debate on the Toyota Production System has failed to provide a clear understanding of the social and organisational conditions that make this system viable. By focusing on the work organisation, the market configuration and the industrial infrastructure of the European transplants of Toyota, this paper proposes an alternative approach centred on the notions of 'contextualisation' and 'human agency.'

Introduction

Since the end of the 1980s and the early 1990s, a wide consensus has been built around a standard description of the Toyota Production System (TPS) as the definitive solution to all the problems that had arisen during the crisis of *fordism* in the 1970s.

The main driver in bringing together this theoretical synthesis has been the *lean production* literature, whose claim that the TPS embodied the one best way for the 21st century relied on two powerful arguments. First, they claimed that by reversing the flux of production from a push to a pull logic, TPS had managed to offset the fluctuations of markets, allowing for a constant optimisation of the production flow through the elimination of all kinds of stocks and waste (Womack *et al*., 1990; Kenney and Florida, 1993). Second, they argued that by involving the industrial workers in this process of constant optimisation through teamwork organisation, TPS had empowered them, breaking the taylorist separation between conception and execution of work, solving, as a result, the problem of their implication and satisfaction at work (Womack *et al*., 1990; Adler, 1992; 1995; Kenney and Florida, 1993; Mishina, 1998; Appelbaum *et al*., 2000).

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The initial good performances in terms of productivity, quality and work satisfaction of the first Japanese transplants in the USA, and in particular NUMMI, played a pivotal role in sustaining this view. They demonstrated that what was called before the Japanese model could be now exported everywhere under the new label of lean production and implemented with success by everybody. Neither the contextual environment represented by different markets and national institutions, nor the employment of workers, whose collective identity and organisation could be potentially hostile and resistant to this new way of management, seemed to matter at all because the inner logic of the TPS appeared to have solved both these problems at their roots.

Despite the fact that not all the Japanese transplants in North America shared, during the 1990s, the same success story (Fucini and Fucini, 1990; Babson, 1995; Boyer *et al*., 1998), that even the most successful ones, such as NUMMI, faced sustained period of crisis and work discontent (Adler *et al*., 1998), and that more generally many Japanese carmakers, once the favourable conditions of the 1980s had faded away, fell to different degrees into severe downturns (Freyssenet *et al*., 1998), the first argument of the lean production theory has remained basically unchallenged until now. If implemented correctly, TPS is still supposed to guarantee today the perfect synchronisation of the production flow with market trends and the constant optimisation of the production process. The isolated effort made by the Groupe d'Etude et de Recherche Permanent sur l'Industrie et les Salariés de l'Automobile network literature to bring back context into the picture (Boyer *et al*., 1998; Freyssenet *et al*., 1998; Boyer and Freyssenet, 2005) has focused mainly on the strategic need to match product development with the evolutions in the structure of the markets by setting pertinent profit strategies, but no attempt has been made so far to identify the conditions that allow a company like Toyota to synchronise efficiently, and, according to the standard description of the TPS, effortlessly, its production with its sales. Certainly, the fact that Toyota remains today one of the most efficient and profitable carmakers in the world continues to bring a sort of an unconditioned support to this theoretical assumption, but the difficulties encountered in Europe by the Japanese carmaker, where it has invested since 1989 more than 3 billion euros for setting up its manufacturing facilities in the UK and France, cumulating so far over 1 billion euros of losses, suggests that context might matter after all even for a company like Toyota and that this dimension deserves a closer effort of analysis and comprehension.

The second claim of the lean production theory that TPS empowers workers and guarantees their implication and satisfaction at work has been, in contrast, heavily challenged during the 1990s. Organised around the 'management by stress' approach pioneered by Parker and Slaughter (1988), a critical literature has surged against the empowerment approach, building on the notions of labour control and hegemonic regimes (Burawoy, 1985). It argued that the systematic transfer of knowledge from workers to managers implied by the teamwork organisation of the TPS allowed for new and more sophisticated patterns of exploitation and subordination of workers to the interests of the firms (Fucini and Fucini, 1990; Garrahan and Stewart, 1992; Graham, 1995; Parker and Slaughter, 1988). Despite its polarised opposition against the 'empowerment' theory, the management by stress view shared with its foe a common set of constitutive limits, which have sensibly constrained the scope of the debate on work practices and teamwork organisation during the 1990s (Hodson, 2001; Vallas, 2006). In particular, like the empowerment approach, the management by stress view adopted a teleological and determinist outlook which consisted in leaving apart any notion of human agency. It considered the teamwork organisation of the TPS, exclusively, as a managerial tool capable of automatically delivering productivity, quality and efficiency through the pervasive submission of the workforce. No attention at all has been paid to the social and organisational conditions that surrounded the implementation of the TPS and its implication to the workers both in Japan and abroad. As a result, Japanese transplants and lean workplaces came to be considered either as perfect machines (the empowerment approach) or highly sophisticated prisons (the management by stress view) and, literally, a veil was cast over their social and organisational dynamics. Despite its declared opposition against the lean

production theory, the management by stress view resulted in the end more than complementary with the main argument of its opponents: the intrinsic superiority of this model and its inevitable diffusion.

The aim of this paper is clearly to move beyond this standard definition of the TPS, and more generally, of the lean production. I will start by shedding some light on the European experience of Toyota, and in particular, on why the global performances of its two transplants in the UK and France have been surprisingly poor, both in terms of industrial efficiency and work satisfaction, which in itself appears as a quite surprising story at the light of the theoretical approaches considered previously; in this first part of the paper, I will stress in particular the need to recontextualise the TPS by showing how much the position hold by Toyota in the different markets and the industrial infrastructure in which the TPS is implemented have a very important impact in determining its viability conditions and by explaining why when Toyota does not control the evolution of its market share and the mix of its sales, a structural contradiction arises between the constant drive for efficiency and the need for extra flexibility, generating periodical crisis in its work organisation, as it happened in Europe in the second half of the 1990s.

In the second part of the paper, I would like to develop a different approach to the teamwork organisation in these plants, moving beyond the sterile opposition between the empowerment and the management by stress views. This will consist in bringing back into the picture the notion of human agency and in focusing on the social and organisational conditions that make the TPS work organisation viable. I will try to show in particular how does teamwork rely here on a complex structure of social interactions and on several different sets of practices in order to achieve the constant reduction of cost required by the system. Because the successful deployment of these activities demands a degree of involvement and social cooperation, which is not embedded into the system and cannot be controlled by the management, this will mean, in conclusion, that even in lean factories, such as the Toyota transplants, labour relations not only still matter, but also may be very important for the dynamic equilibrium of this system.

The research presented here is based on extended fieldwork in both Toyota Motor Manufacturing UK (TMUK) and Toyota Motor Manufacturing France (TMMF), which took place since June 2001 for TMUK and February 2003 for TMMF. This project has been developed in the context of an ongoing PhD thesis at the École des Hautes Études en Sciences Sociales in Paris, and through a constant involvement in the activities of the GERPISA network. The support of local unions (AMICUS in the UK; Force Ouvrière, Confédération Générale des Travailleurs, Confédération Francaise des Travailleurs Chrétiens and Confédération Générale des Cadres in France) has been particularly important to guarantee a constant access to workers for interviews and to company data during the whole period. Contact has been also maintained with the former British manager of human resources in TMUK, now in charge of the coordination of the human resources policies at the European level. A quite unique set of historical data has been collected, detailing for both plants the evolution in the workforce composition, in the level of workforce turnover, promotion and disciplinary trends, in the changes in the production planning, in the overtime levels, and in the internal indicators for productivity, quality and health and safety. The minutes of company councils in both plants for the period 1997–2005 for TMUK and 2002–2004 for TMMF have also been collected along with group leaders' briefs and other company documents, such as internal surveys, evaluation procedures, disciplinary hearings (provided individually by workers concerned), standard work sheets or health and safety guidelines. The annual accounts of both plants have also been used to determine the level of profitability, investments and assets from the start of operations until the financial year 2004.

In this paper, I will make particular use of a qualitative survey made in 2001 with 10 of the 12 workers' representatives elected in TMUK, when a questionnaire has been distributed through the union office to the workers' representatives. This has been followed by a series of interviews with the workers' representatives to make sense of the results, with the aim of providing a detailed description of teamwork dynamics and

work practices as the establishment of the standard task of work, the development of kaizen activities and the use of the andon cord. The workers' representatives interviewed were all involved in shop floor and manufacturing activities, had, on average, between seven and nine years of service and had been in the Toyota Members' Advisory Board (TMAB) for at least two years. The results of this research have been considered within the trajectory of the plant in order to understand the relationship between teamwork dynamics, market trends and production planning, and changes in productivity, quality and safety indicators. This methodology will be used in particular in the last part of the article that focuses on the use of the andon cord. A similar qualitative work based on interviews has been conducted in TMMF, to compare teamwork dynamics and work practices in both plants. The aim here was to see whether or not the social and organisational conditions for the deployment of these activities vary according to different industrial and social settings.

1. The viability conditions of TPS in Europe: an emerging structural lack of flexibility

To put in very simple terms at the risk of some degree of simplification, the main engine of the TPS is the constant reduction of costs through the systematic elimination of any type of waste (Womack *et al*., 1990; Oliver and Wilkinson, 1992; Shimizu, 1999). The immediate and most evident effect of this permanent reduction of unnecessary resources is the creation of a lean flow of production because it is devoid of intermediate stocks, where any kind of problem or hidden dysfunction will inevitably emerge, allowing the team to constantly optimise locally the process of production (*kaizen*). One of the problems of this system is that the constant elimination of waste cannot be done on the basis of the real evolution of the demand because this keeps fluctuating and requires, therefore, the levelling out of the volumes of production (*heijunka*) in order to be effective (Coleman and Vaghefi, 1994; Monden, 1994; Hampson, 1999). The balance of production relies on the capability of the distribution network of 'stabilising' the sales by controlling and reducing their fluctuations against the production plans, which is something that plays a key role in the long term viability of TPS, even if we still know very little on how this is actually achieved (Shimizu, 1999; Pardi, 2006a). When Toyota realises this 'stabilisation' of sales, as it has been the case for most of the time in Japan,[1] and more recently in the US, the TPS can drive down the costs building on stable volumes of production, creating therefore the favourable conditions for the development of kaizen activities; but when this condition is not satisfied and the volumes of sales are not stabilised, as it has been generally the case for the European market in these last years (see later for an analysis of the European market), the system undergoes a structural crisis: its underlying logic, which demands the systematic reduction of unnecessary resources in order to achieve a forecast volume of production, starts to be in contradiction with the need of either having resources in excess to produce cars beyond the planned volume of production, or getting rid of resources which have become suddenly unnecessary when the production volumes are lower than those initially forecast (see Pardi, 2005a for a detailed analysis of the TMUK case). Under these conditions, the normal kaizen activities, instead of delivering more efficiency, tend to amplify dramatically the unbalance of the production flow (Berggren, 1992; Hampson, 1999), saturating quickly the very restrained margins of flexibility of the TPS and transcending the boundaries of its social sustainability. In a way what happens is that the drive for local efficiency compromises the systemic stability of the production flow because it reduces the slack in the flow that the system would need to cope with the unplanned fluctuations, making the work organisation more fragile. The impact of these crises will vary significantly according to many different factors, such as their length and magnitude, the degree of external flexibility embedded in the industrial infrastructure of the production site, and the capability of the teamwork organisation to deal efficiently with unplanned fluctuations in the production schedule.

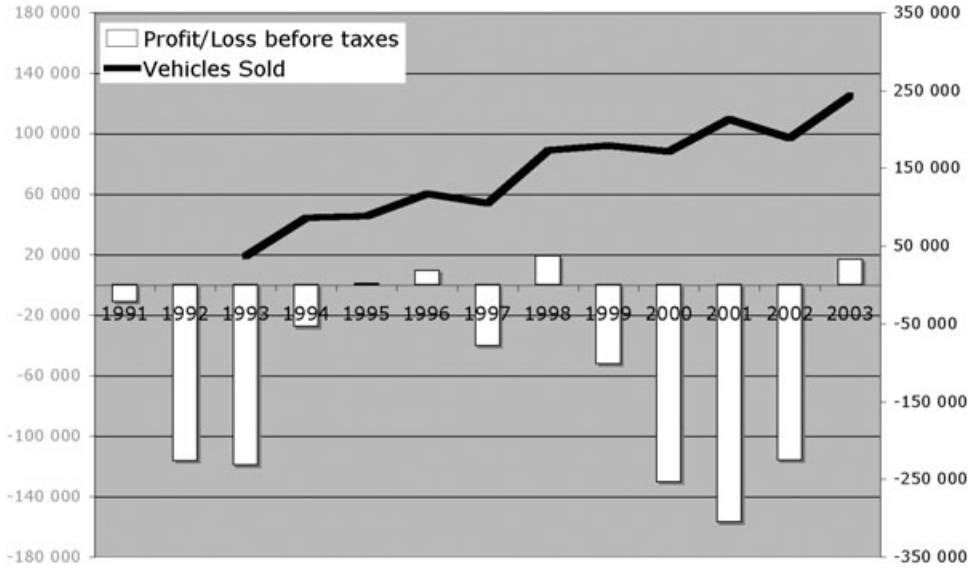
The paper will focus in particular on this latter dimension, but it should not be underestimated here the importance of the industrial infrastructure dimension in considering the viability conditions of teamwork in overseas plants. Toyota has in fact in Japan, all around and within the Toyota City area, a quite unique concentration of production sites, surrounded by the plants of all its major suppliers and supported by a large population of stable and temporary workers who are highly experienced and skilful. Not only are these plants, on average, bigger than the overseas transplants, but they rely also on larger volumes per platform with lines which can manufacture and assemble different models simultaneously. When unplanned fluctuations in the production schedule occur in this context, Japanese plants can shift models across common platforms, can transfer workforce between factories, and in the worst cases, can fall back on their first-tier suppliers, who can also perform assembly operations of final vehicles. It is worth reminding here that Toyota still concentrates 75 per cent of their global operative profits in Japan where only 46 per cent of the actual sales are made (average for the 1998–2004 period; source: TMC, 1990–2005), whilst the North American region represents 36 per cent of the sales and 23 per cent of the operative profits for the same period, and Europe represents 9 per cent of the sales but only 0.5 per cent of the operative profits (source: *idem*).

The large production volumes attained by the American plants during the 1990s, and the fact that the main first-tier suppliers of the Japanese keiretsu have followed Toyota in the US and Canada, means that the North American configuration has developed to a much lesser extent a similar degree of external flexibility; moreover, the company has enjoyed here a strong and highly profitable market position for most of the last 30 years, which has allowed for a quite efficient stabilisation of the volumes of sale. The case of Europe is clearly different. The volumes of sales of Toyota have been stagnant here for most of the 1990s: in 1990 they were of 450,800 vehicles, by 1996 they have progressively fallen to 360,000 vehicles, and still in 2000 they were only of 690,000 vehicles for a market share of 3.8 per cent. Since 2000, sales have progressively grown to reach, by the end of 2004, 979,000 vehicles and a market share of 4.9 per cent, both because of the extraordinary success of the Yaris, which is by far the most sold Toyota vehicle in Europe (220,000 units in 2004) and because of the positive impact of the east European market, which is now included in the European accounts of TMC (source: Toyota Motor Company, *Annual Reports*, 1990–2005). Not only the European market is very heterogeneous but also extremely competitive, making it particularly difficult to forecast and stabilise sales against production plans. Moreover, the Toyota production plants are scattered in different countries for political and strategic reasons, and it is almost impossible to transfer workforce between them. Their internal flexibility is also particularly low because all the European production lines manufacture single models, which, in some cases, are solely produced in Europe, such as the Avensis in TMUK. All together this means that these plants are very often confronted with unplanned fluctuations in the production schedule, and when these fluctuations occur, the main source of flexibility available to meet them is the internal teamwork organisation. This has led, as I will show in the following pages, to an emerging structural lack of flexibility that has sensibly affected the teamwork dynamics in both transplants.

TMUK: compulsory overtime and work crisis

In TMUK, during the end of the 1990s and the first years of the 2000s, the level of compulsory overtime per head has regularly overcome the 30 hours per month on average (with the only exception of 1999, where the monthly average dropped at 14.5 hours per head), bringing a growing number of supervisors and workers to overstep the legal limit of 48 hours per week (Pardi, 2005a). As we will see better later, this has produced a dramatic deterioration of the working conditions and has seriously compromised the social cohesion of the teams.

Moreover, since 1999, TMUK has started to employ agency workers, whilst in the background half of the experienced workforce was quitting the plant during the 1997–2000 period (Pardi, 2005a), when the transplant was not only facing regular



Source: TMUK (1992–2005).
Figure 1: Toyota Motor Manufacturing (TMUK) 1991–2003—in thousands of pounds

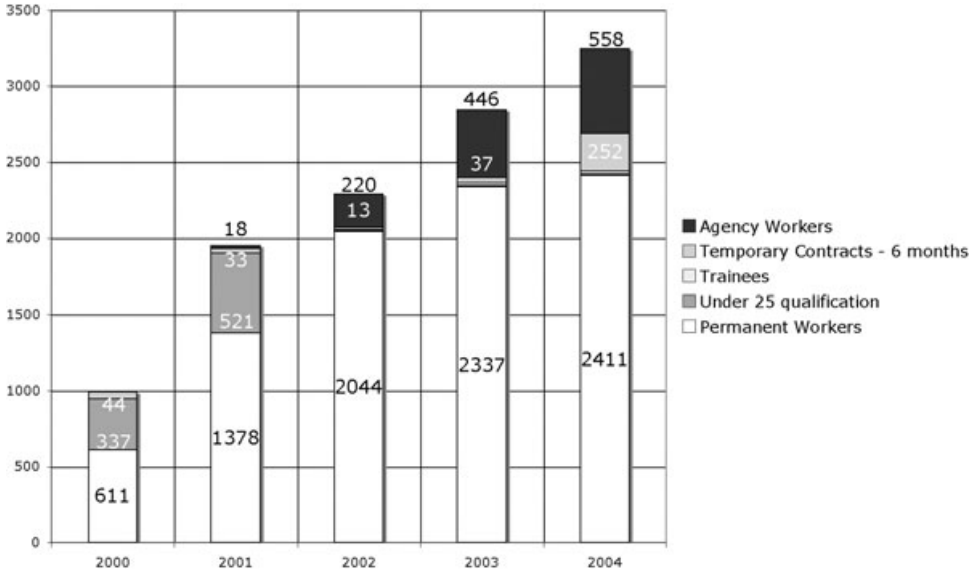
unplanned fluctuations in the production schedule but also a significant pressure on its margin due to the rapid appreciation of the pound against the euro.

This meant that the deployment of ambitious kaizen activities to reduce the impact of the financial crisis was crashing against the need to constantly rebalance the lines because the average volume per day and the takt time kept changing during this period (Pardi, 2006b), leading, on the one hand, to a cumulated loss of £455 million in four years (see Figure 1), and, on the other hand, to a profound crisis of the teamwork organisation inside the plant (Pardi, 2005b).

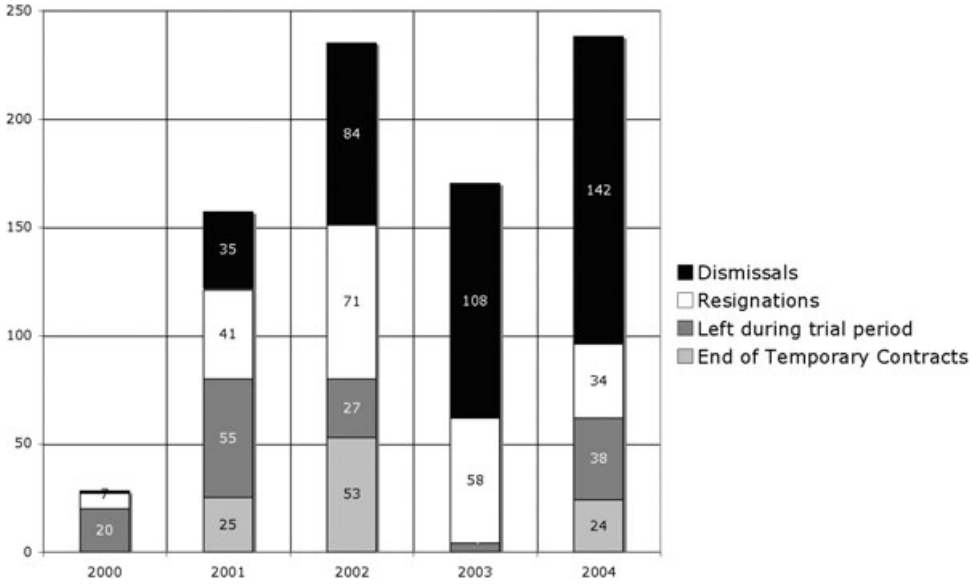
TMMF: agency workers and authoritarian management

The case of TMMF is different. From the outset of the production of the Yaris, which has started in 2001, the French plant has used agency workers as a permanent element of its teamwork organisation, providing a structural buffer to deal with unplanned fluctuations in the production schedule. As we can see in Figure 2, agency and temporary workers represented, by 2004, more than one-fourth of the whole workforce (810 on 3221). On average, every team is composed here of 4.3 team members and of 1.3 agency workers, whilst in TMUK the average team is composed of four team members and of less than 0.5 agency workers.[2]

TMMF is also characterised by a more authoritarian style of management, which is partially due to the fact that the French executive directors have been given from the very beginning a much larger margin of autonomy than their colleagues in the UK (Kumon, 2005). This stands out clearly from the quite surprising and growing level of workers fired during the first four years of production (35 in 2001, 84 in 2002, 108 in 2003 and 142 in 2004: see Figure 3) as the result of an over-zealous application of disciplinary procedures. Moreover, contrary to what had happened in the British plant, there has not been here any real effort to move away from the standard authoritarian supervisor–subordinate relationship embedded in the French industrial system. This also reflected the need to increase the volume of production much faster than in TMUK (as shown in Figure 4), which was a precondition for the business viability of the



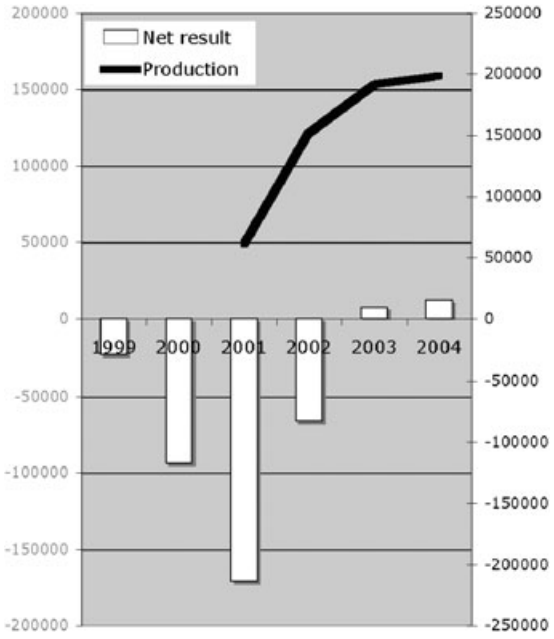
Source: TMMF (2001–2004).
Figure 2: Workforce composition Toyota Motor Manufacturing France (TMMF, 2000–2004)



Source: TMMF (2001–2004).
Figure 3: Toyota Motor Manufacturing France (TMMF) leavers (2000–2004)

project because the margins of the Yaris (sold on average between €8,000 and €10,000) were, by definition, much smaller than those of the Avensis (sold on average between €16,000 and €20,000).

As a result, the teamwork organisation of TMMF appears today as much more top-down oriented than in TMUK, with a relative low involvement of team members



Source: TMMF (2000–2005).
Figure 4: Toyota Motor Manufacturing France (TMMF), 1999–2004—in thousand of euros

and team leaders in the design of work stations and the deployment of kaizen activities as we will see better later. An aspect that also explains why the integration of a high number of agency workers poses here less problems than in the British transplant, where its introduction in 1999 has significantly perturbed the teamwork organisation (Pardi, 2005a).

Such a configuration seems to fit, for the moment, with a plant which is manufacturing a model easy to produce and assemble, characterised by a very limited variety, with quality standards far below those demanded by the Avensis and the Corolla, and whose profitability will be guaranteed by high production volumes, more than constant cost-reduction activities.

Nonetheless, this authoritarian teamwork dynamic has already set the labour relations climate of the factory on a pattern of conflict, marked by a very high level of turnover (see Figure 3): almost one-third of the workers hired during the first four years have already left the company (22 per cent of those hired in 1999, 24 per cent of those hired in 2000, 37 per cent of those hired in 2001—the first year of production—and 26 per cent of those hired in 2002), and this despite the careful and extended selection of the workforce, an unemployment rate which hovers above 20 per cent in the Nord-Pas de Calais region, and the fact that the early stages of development of the plant did actually offer significant opportunities of promotion and career for those who managed to stay: 381 team members were in fact promoted to team leaders during the first three years of production between 2001 and 2004 (TMMF, 2001–2004).

2. Teamwork dynamics: beyond empowerment and management by stress

It is clear that the constant amelioration of the production process implied by the concept of *kaizen* cannot be achieved without a very constraining organisation of work. The work tasks in the TPS are completely standardised, to the point that each standard task sheet does not only state the whole sequence of the operations, but also the exact

positions and movements that the worker must perform. The capability of executing the standard task according to the standard task sheet is evaluated every month by the team leader, and it is one of the conditions to get the basic note of 2 out of 4 marks (from 0 to 4) in the final year individual appraisal, which is assigned by the group leader. From this appraisal will depend the evolution of the salary, the access to vocational training and the chances of promotion of each team member, both in TMUK and in TMMF, a point to which I will go back later more in detail when I will discuss the use of the andon cord, which is also strictly submitted to the evaluation of the group leaders.

The exact execution of the standard task is supposed to be more important than the pure speed of execution because the standard task is normally approved by the health and safety specialist of each zone in order to be performed at a certain cycle time and during a determined period of time. In principle, the exact execution of the standard task should not engender any kind of injuries or muscular skeleton syndromes, at the condition however of making regular rotations between work stations, which is something that requires a minimal degree of polyvalence. That is why deviations from the standard task are supposed to be immediately sanctioned by the team leader because they can compromise the safety of work and the quality of the product. For this very same reason, the standard task and its execution imply a very monotone work, even more monotone than what could have been experimented on the 'classic' fordist line, where at least the operators enjoyed some kind of autonomy in the way the task was performed (Durand and Hatzfeld, 2003). However, the main difference from the fordist line would consist here in the fact that the standard task is not established anymore by the shop office, as the taylorist principle of the separation of the design and organisation of work from its execution would require, but by the same operators and work teams, who would be therefore pushed by their learning by doing towards a constant improvement of the production flow.

Lean production advocates see this system as an important degree of empowerment for the workers because through the use of their knowledge and of their intellectual capacities in designing and optimising the production process, they would enjoy a much higher satisfaction at work and significantly better working conditions than in the fordist system. A view, which has been heavily criticised by the approach of the management by stress, that argues on the contrary that once the protection embodied by the personal know-how of the operators is taken away from them, the transparency of the production process generated by this transfer of knowledge permits the management to intensify systematically the pace of work.

As we will get into a more detailed description of how the standard task is established and how the kaizen activities are developed and implemented in TMUK and TMMF, it will become clear that the 'empowerment view' significantly overstates the role and the autonomy of the operator, and to a certain extent, also of the team leader. On the other hand, the 'management by stress' view tends to oversimplify the problem of the worker implication and cooperation in this system. The social cohesion of the team and the social viability and sustainability of the work organisation are not embedded into the system, they are the results of compromises and social dynamics that cannot be controlled by the management.

How the standard task is designed and modified

As it has been already emphasised (Sey, 2000), most of the descriptions of standard work published during the 1990s suggest incorrectly that team members conceive and modify their tasks with the only involvement of their team leader (Womack *et al*., 1990: 117; Kenney and Florida, 1993: 106; Adler *et al*., 1998: 132, 134). Now, as the word 'standard' suggests in the first place, every modification of the standard task of work has to be first tested by the supervisor, then authorised by a senior supervisor, and finally standardised with the help of an engineer and of a health and safety specialist, a sequence which implies therefore a number of actors much more important than just

Table 1: The standard task

How much influence do the following have over deciding the standard operation

	A lot	Some	A little	None	Don't know
Team member	4 (1)	2 (1)	4 (4)		
Team leader	6 (2)	4 (4)			
Group leader	8 (4)	2 (2)			
Engineer	4 (4)	4 (2)	2		
Specialist	6 (6)	2	2		

Source: Toyota Shop Stewards and AEEU members questionnaire (2001).
Note: Between brackets the result only from answers from TM.

the team member and his team leader. Moreover, most of the time, the team members are not even the main actors in this sequence.

According to the answers to a questionnaire I have distributed to the 10 shop floor workers' representatives of TMUK in 2001[3] (see Table 1), those who have the largest influence on the establishment of the standard task are the group leaders, followed by the team leaders, the health and safety specialists, the engineers and finally the team members (for a visual representation of the labour organisation and its hierarchical levels see Figure 5).

Although, if the answers relatively concur in attributing to group leaders and team leaders a significant influence, the role of the specialists and engineers appears to be more controversial, and the perception of the influence of the team members results perfectly polarised between those who think that they have a lot of influence and those who think that they have just a little. These differences tend to reflect, on the one hand, the position hold inside the team by each workers' representative and their respective place of work: for example, team members attribute, on average, less influence to themselves and to the team leaders and much more influence to the specialists and the engineers, whilst those who work in the assembly line, whether they are team members or team leaders, tend to attribute only 'little' influence to the team members. On the other hand, this divergence in the answers reflects also the existence of two different kinds of sequence in the process of 'standard task design' which coexist on the shop floor and where team members have a significant different role to play. These 'sequences' have been identified through interviews with the representatives involved in the survey, and then discussed and analysed with workers and managers both in TMUK and TMMF.

In the first sequence that I have labelled bottom-up sequence (see Figure 5), a team member, but much more often the whole team, communicates to their team leader that he would like to modify the standard work. This can happen before the start of the shift or during a meeting demanded in advance by the team member or the team altogether. The team leader listens to the proposition and evaluates its impact, and in case he thinks it is a good idea, he will speak to the group leader. If the group leader agrees and if the modification does not demand an important redesign of the task, he will simply change the standard task sheet, give a copy of the new sheet to the senior group leader and to the health and safety specialist so that they are informed, and modify accordingly the standardised work visual control board. However, if the change implies a more complex redesign of the task, the group leader will demand the intervention of the health and safety specialist of his zone, and if the new task requires changes in the organisation of the workstation or in the organisation of the inventories, he will call for an engineer or for his senior group leader to come and check it out: the new standard task will be then tested outside the normal working time, and if approved, standardised.

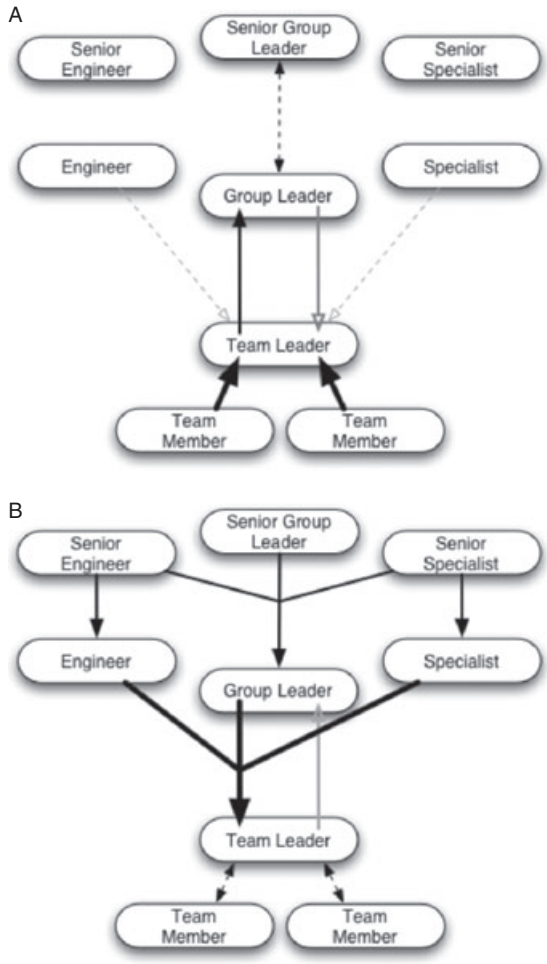


Figure 5: Sequences of standard task design

The second kind of sequence, which I have labelled top-down sequence (see Figure 5), is almost symmetrical to the first one. A group leader, often under the pressure of targets set by his senior group leader and decided in the first place by the shop manager, will have to come up with a new design of the standard task to suit, for example, a lower *takt time* or to reduce the number of workers in one of his teams. In order to do this, he will demand the cooperation of his team leaders, who will normally look themselves for solutions outside working time, mainly without the involvement of their team members. Once the new task is designed, the engineer and the specialist of zone will come over to check and to certify the new standard work and the senior group leader will control if the initial target has been achieved. Only at the end of this process that the new task will be tested by the team members, who will have a chance to propose some adaptations or minor modifications, even if the final word will always stay with the group leader. In TMMF, the top-down sequence is mainly managed by *ad hoc* kaizen teams who work offline and are not involved in the daily manufacturing process, reproducing therefore, to a certain degree, the taylorist separation of conception and execution. This is a trend reinforced by the limit impact of bottom-up activities, which are firmly controlled in TMMF by each group leader.

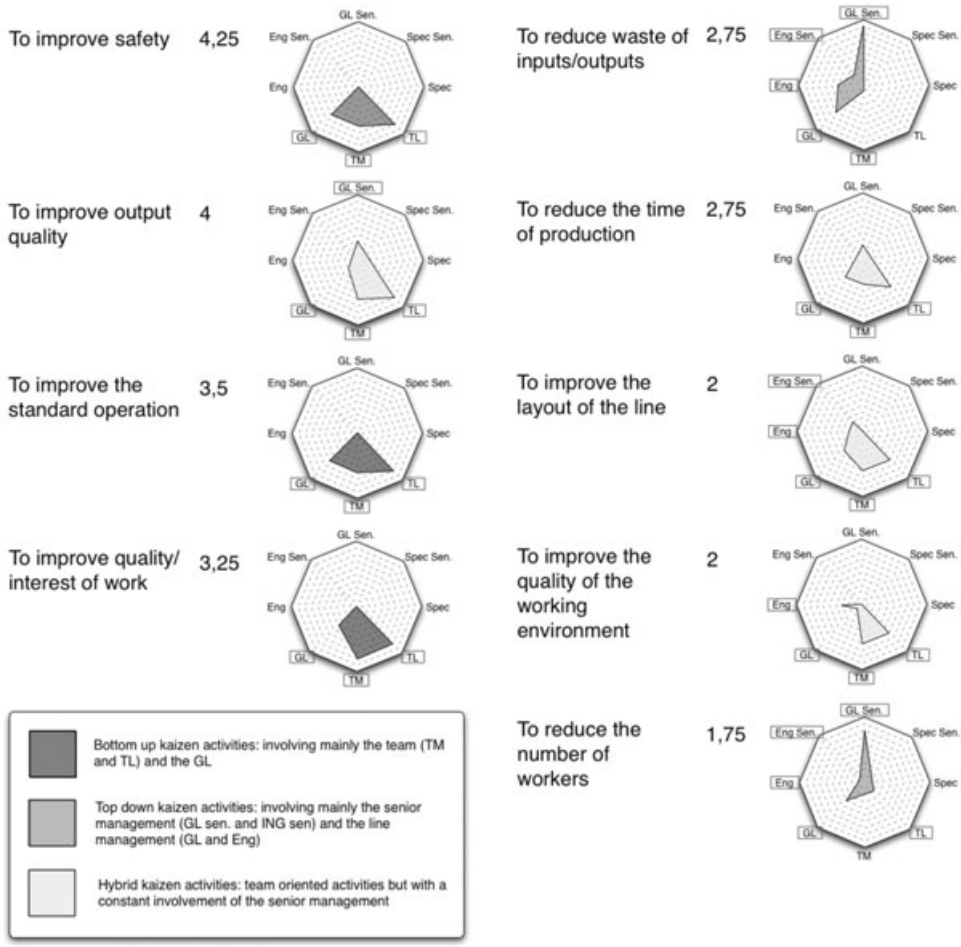
As I have said before, these are broad sequences that may take sensibly different shapes on the shop floor according to the production context and the social

configuration of teams and groups of production. This basic distinction however between top-down activities, involving supervisors and the senior management, and bottom-up activities, organised around the team with a stronger role for team members and team leaders, not only holds true, but it also becomes even clearer when applied to the analysis of the kaizen activities as a whole.

Variety and multiplicity of kaizen activities

In the same 2001 questionnaire I have asked the workers' representatives to indicate the importance of each kaizen activity with a number between 0 (not important at all) and 5 (very important), and to specify for each of them the three shop floor actors who are most involved in their development.

According to their answers (see Figure 6), the most important kaizen activities in TMUK, at least in the summer of 2001, were to improve safety (4.25) and the quality of products (4), followed by the improvement of the standard task (3.5) and of the quality/interest of work (3.25), whilst the reduction of the time of production (2.75), of the waste of inputs (2.75), and above all of the number of workers (1.75), which have been normally considered as the main targets of *kaizen*, figured at the bottom of the list.



Source: Toyota Shop Stewards and AEEU members questionnaire (2001).
Figure 6: Kaizen Activities (Toyota Motor Manufacturing, 2001)

Yet, if we look into the categories underlined as the most involved in each activity, we can see how the reduction of the number of workers is fundamentally an activity managed by the senior group leader and the group leader, with a minimal involvement of the team of production, as it is also the case for the reduction of the waste of inputs. Moreover, many workers' representatives have stressed how these activities become the highest priority in the starting up phase for a new model, or for a restyling, whilst they fall into the background once the assembly flow has been stabilised.

It is therefore possible to identify two distinct groups of kaizen activities which partially summon up the definition of 'great kaizen' and 'small kaizen' proposed by Shimizu (1999). The reductions of the waste of inputs and of the number of workers fit into the 'great kaizen' definition: top-down activities clearly directed at obtaining gains of productivity and managed by supervisors and senior management; whilst the improvement of safety, of the standard work and of the quality/interest of work corresponds to the 'small kaizen' definition: bottom-up activities carried out at the team scale with low or no impact on productivity. In the middle, there is a third set of activities—to reduce the time of production, to improve the output quality, the layout of the line and the quality of the working environment—which are still carried out at the scale of the group of work, with a clear involvement of the team, but which also require the active control of the supervisors and of the senior management.

The variability identified before in the setting up of the standard task acquires here an increased and extended meaning. In effect, behind the general principle of the constant amelioration of the production process, it is possible to discern sensibly different sets of activities depending on the priority given to them. Not only each kind of kaizen implies a particular configuration of actors, but the different objectives embodied in each of them entail also contradictory effects on the organisation of production and work. That is why the definition of an order of priority is central to be able to organise simultaneously these different activities. This order, however, is far from being stable, not only it evolves according to different phases in the product cycle and changes in the market environment, but it also varies geographically within the plant, each shop having its own specific targets.

It is for example clear that when a new model is launched, the priority will go to the reduction of any kind of waste and of the number of workers to increase productivity and guarantees a minimal degree of profitability per unit by the reduction of costs. During this phase, the core of the kaizen activities will be placed under the control of senior management and supervisors, and the standard task will be imposed from above, following the top-down pattern. Once production will be stabilised and the productivity targets achieved, the priority will shift back towards the improvement of security, quality, the standard work and the interest of work, involving a much greater role for team members and team leaders and a more autonomous management of the standard task within the team of production.

In reality, however, such a clear distinction between different phases does not exist and all kaizen activities are carried on simultaneously, bringing the team under the permanent pressure of contradictory forces. This is a fundamental feature of the TPS that works by putting into tension the opposite poles of the problems which it is supposed to solve. For example, the kaizen activities, whose principle aim is the constant amelioration of the production process, have as their main priority the protection of the safety of work, which they naturally threat. In the same way, when the pace of work is intensified, the main priority goes to the improvement of the quality standards. Something similar applies to the establishment of the standard task, which constantly opposes the requirement for control and the need for autonomy in order to be efficiently developed. Even the management of health and safety employs the same logic by opposing the necessity of working long hours under the stressing conditions of the lean flow and the need of preventing absences and injuries because the number of workers on the line must always be the minimum required by the production plan.

The balance of this management system tends to be naturally unstable because its components stay into a relationship of mutual dependence. Its normal dynamic is to

create regular situations of crisis which are the logic consequence of these inner tensions and are expected to be solved locally by the team and by the other actors of the shop floor. As we have seen previously, the resolution of these 'crises' is achieved through the simultaneous activities of multiple networks of actors, sometimes localised within the group or just within the team, sometimes crossing through the shop floor, involving more complex relationship and interactions. The efficiency of such an interconnected web of activities cannot be imposed by the simple organisation of the teamwork or dictated by the flow of production, it requires a shared set of skills, the knowledge of a high variety of procedures and the establishment of stable social relationships based on a minimal degree of mutual trust and respect. When these conditions are in place, the stress implied by the system does not undermine the social solidarity of the workers, who can indeed experience some degree of satisfaction at work, whilst each 'crisis' can be solved locally before it starts affecting other elements of the system (this has notably been the case in the first years of production in TMUK, which has enjoyed a much longer build-up phase than TMMF).

In the next section, however, I will try to show what happens when these conditions are not fully in place by taking the example of the andon cord, which is the tool that is charged of solving the constant contradiction that arises between the need to increase productivity and the priority of protecting the quality of the product.

3. A tool under pressure: prescription and practice in the use of the andon cord

It is generally said that the andon cord allows team members to stop the line whenever they spot a quality or a process problem that they cannot fix (Womack *et al.*, 1990: 73; Spear and Bowen, 1999: 101). In reality, the role of team members is just to call for help when they cannot achieve the standard operation and it is under the responsibility of the team leader to check if the problem can be solved during the remaining cycle time. If this is the case, he pulls the andon cord a second time to turn off the intermittent yellow light on the andon board, otherwise, he lets the line stop and the group leader will come over to check the situation. Most of the time, however, the first thing the team leader does is to immediately pull the andon cord a second time to switch off the light and to prevent the line from stopping. He will then keep working on the problem even when the car enters into the next assembly zone, which is of course a significant deviation from the rule. Sometimes, if this is not possible, he will cut through the lines to access the car between segments or he will call the quality team at the end of the assembly shop to alert them about the problem. These latter practices however are more common in TMMF than in TMUK because the compact layout of the French factory makes it easier for team leaders to cut through the line segments and for group leaders to make quick visits to the final inspection line in order to check the level of faults in their zones and at times to even negotiate about these levels.

The way team leaders deal with the andon in these factories gives therefore a clear priority to the operational rate (OR) of the line over the quality of production. Both in TMUK and TMMF, the line tends in fact to stop only when many andon are activated at the same time or when a major maintenance problem arises. The OR is measured in real time and displayed in percentage over the assembly shop: the standard target for Toyota lines is between 90 and 95 per cent, which permits a minimal slack to allow workers to cope with problems and use the andon cord, but when the OR falls behind the target, this means that the daily volume of production will not be attained and that some compulsory overtime will be needed to achieve it. Quality instead is measured *ex post* mainly by two variables, the *chokkoritsu* (also known as the first run rate), which indicates, on average, how many cars have been taken out of the final inspection line in order to be fixed, and the defaults per vehicle rate, which underlines the average number of defaults recorded per vehicle by the quality inspection teams.

In order to encourage team members to stop the line in presence of problems, the whole assembly line, both in TMUK and TMMF, has been cut in many sub-lines to relieve

team members from the responsibility of using the andon because there are now buffers between the sub-lines which allow the production to continue even when a segment has been stopped (Fujimoto, 1999; Shimizu, 1999). However, in the daily work environment, the use of the andon is always put under a strong pressure, above all when the cycle time is short and the OR is already falling below the target. The use of the andon implies indeed a constant trade-off between quality and productivity, and the team member is evaluated on both by his group leader: on the one hand, quality faults can be tracked back to the team member and recorded in his progress review worksheet; on the other hand, the 'correct utilisation' of the andon cord is also strictly weighted.

In theory, pulling the andon to prevent a quality problem should always fit into the definition of a 'correct utilisation.' However, in both transplants, the individual appraisal system has progressively evolved into a disciplinary tool used by group leaders to better control their subordinates. This has been essentially the consequence of the deterioration of the hierarchical relationship triggered by the growing feeling of frustration of the workforce with the lack of promotion, which was due to the flat qualification systems used by Toyota and to the age proximity between levels implied by the recruitment policy of the company—in TMMF, for example, the average age of team members is 28, of team leaders is 29, of group leaders is 33 and of managers is 35 (TMMF, 2001–2004). Moreover, by focusing solely on the performance of individuals, the evaluation system relied completely on the subjective arbitration of group leaders, whose judgements could not be appealed under any circumstances (for a more detailed description of the evaluation process see Pardi, 2005a). This means that what matters in choosing between pulling the andon or letting the fault go, is in the end just what the group leader wants. A situation which leaves the team member in front of a difficult decision that he has to take in the interval of just few seconds: should I give the priority to productivity and let the fault go by or to quality and use the andon?

The answer, which always in theory should be at all times 'the andon' according to the rules, will depend instead on many interconnected factors associated with the social system of relationship in place between team members, team leaders and group leaders, and with the specific industrial context in which the plant operates at that given time. If we take in consideration what has happened in TMUK during the 1998–2002 crisis, we can see for example how the uncertainty which surrounded the use of the andon cord has rapidly evolved into both a dramatic decline in the quality of production and a serious deterioration of the team leader–group leader relationship.

The 1998–2002 crisis: deviant practices and unplanned fluctuations

At the origin of the crisis, there were two unrelated factors: on the one hand, the introduction of the euro in 1999, which has accelerated the appreciation of the pound over the other European currencies, reducing therefore the margins of TMUK, which exports 75 per cent of its production to the continent; on the other hand, the constant fluctuations in the volume of production due to the discrepancies between the plan of production and the actual sales of Toyota in the European market, which have led to a systematic utilisation of overtime. With the only exception of 1999, overtime levels have always surpassed the threshold of 30 monthly hours per head between 1998 and 2002. This has generated quite logically a dramatic raise in the work-related pathologies and in the general rate of absenteeism due to the cumulated impact of the fatigue, the stress and the psychological pressure generated by the lack of rest. In 2000 alone, the number of workers in Activity Limitation increased by 69 per cent, whilst those in the Member Recovery Plan level 2 (MPR2, state of extended fatigue which precedes the AL) rose by 79 per cent (Toyota Members' Advisory Board—minutes, 05/02/2001). Consequently, the absenteeism rate moved from 1.97 per cent in 1998 to 3.11 per cent in 2000, breaching for the first time the threshold of 2 per cent, which is considered by Toyota as the structural limit for working efficiently in just-in-time (Toyota Members' Advisory Board—minutes-, 07/02/2000; 05/02/2001). As a result, a growing number of team leaders were required to take the place of injured or absent team members

directly on the line, making much more difficult for them to deal with andon-related problems. Not only team members were well aware of this, but they were also under an overwhelming peer pressure for not stopping the line because overtime had obviously become one of the major sources of discontent on the shop floor. In such a context, the deviant practices which had set into the teamwork environment of TMUK has led to a significant drop in the quality of production and to a parallel increasing sense of frustration amongst the workforce. For the Avensis, the number of defaults per vehicle doubled between 1999 and 2000 from 0.5 to 1 and for the Corolla, it rose four-fold from 0.4 to 1.6 (Toyota Members' Advisory Board—minutes, 02/10/2000). Most of these faults came from elements that were not supposed to be checked by quality teams: the B faults, which normally are under the direct responsibility of team members. This meant that the team members were not following anymore the standard task of work, or that they could not manage anymore to follow it, but they would not stop the line to let their team leaders take care of it.

It has proved very difficult for the top management to deal effectively with this situation because the deviant practices correlated with the utilisation of the andon cord were indeed embedded into the socio-technical dynamics of teamwork. This is well illustrated by the contrasting view expressed by the management and by the workers on the origin of the problem. On the one hand, the slogan pushed by the management was 'let's go back to the basis,' implying that the problem resided in team members no longer following the rules in terms of standard work and andon utilisation (TMAB, 05/02/2001), and that the solution was to retrain one by one all the team members; on the other hand, team members stressed clearly in the 2000 Toyota Member Opinion Survey (TMUK, 2000) that one of the major sources of their discontent was the difficulty to assure the quality of production under the pressure of other priorities like cost reduction and the operative rates of the lines, which they also strongly associated with several problems connected with the evaluation system (TMAB, 04/06/2001). They were therefore clearly saying that the problem was due to the management style of their supervisors, in particular, of their group leaders because it was too authoritarian, erratic and incapable of preserving the total quality control supposed by the system, compromising therefore the dynamic stability of procedures and routines on the shop floor.

Even if there are no clear signs that TMMF will undergo in the next future a similar situation of crisis, at least until the production planning of the Yaris will be kept stable, the teamwork dynamics in the French plant resemble already very closely to those of the British plant: antagonistic relationship between hierarchical levels, worker dissatisfaction with work conditions and practices, high level of workforce turnover and disciplinary corrective actions, and the diffusion of deviant work practices in the daily achievement of the production tasks. The difference, however, is that here this has not been the consequence of a progressive and unintentional deviation from what could be thought as a 'coherent' implementation of the TPS, but the direct outcome of the top and middle management strategy, which from the outset has privileged the top-down patterns in shaping the organisation of teamwork, and has marginalised the role of bottom-up activities.

Conclusion

The main point advanced by this article is that the TPS becomes a much less efficient system on the long run without a stable relationship between the actors of the shop floor and without a minimal protection of the social sustainability of its work organisation. TPS exerts, in fact, a constant pressure on the workers and on the team organisation by forcing on them contradictory priorities. This is particularly evident when unplanned fluctuations in the production schedule occur and a fundamental contradiction arises between the kaizen dynamic and the heyjunka dynamic, or in more common terms between the constant need to optimise the system by eliminating any kind of waste and the equal decisive need to stabilise and synchronise the production flow. As we have seen in the paper, the teams deal with these contradictory priorities

through a set of organising tools, such as the design of the standard work, the articulation of the kaizen activities, or the use of the andon cord, which far from the simplified descriptions dominant in the existing literature, imply the simultaneous deployment of different networks of actors combining top-down and bottom-up activities harmoniously, and demands therefore a degree of commitment, experience, shared knowledge and solidarity, which cannot be enforced by the system or obtained through disciplinary procedures.

When this social balance is compromised because of the authoritarian style of the management, of the high workforce turnover or of problematic labour relations, the dynamic equilibrium of the system is also in danger, and under the pressure of the periodic crises generated by the normal functioning of the TPS and aggravated by unplanned fluctuations in the production volumes, deviant practices can set in at the place of normal procedures, as in the case of the andon cord analysed here, and vicious circles can spread through the system, transforming a periodical crisis into a structural crisis like it has happened in TMUK.

Nevertheless, in evaluating the global viability of the TPS, it is also important to consider: (1) the market environment in which the system operates—whether or not Toyota is able, through its distribution system and marketing organisation, to control and stabilise the progression of sales in line with its targets; (2) the industrial configuration supporting it—whether or not the manufacturing plants can rely on external sources of flexibility represented by neighbouring Toyota plants, by supplier plants within the Toyota keiretsu and by large supply of trained temporary workers, all conditions which are ideally combined in the unique setting of Toyota City, but which are almost impossible to reproduce completely abroad.

Since both the European plants cannot rely on external sources of flexibility and have to deal with a very competitive market where Toyota is not a dominant player and cannot exert the same degree of control as in the USA and in Japan, the pressure exerted by the TPS here is very high. This explains why these factories appear to be particularly vulnerable to unplanned fluctuations in the volumes of production and to severe work crises. In this context, the TPS appears as a particular fragile system with respect to its capability of delivering profits and efficiency, and to its need of preserving both the engagement and the implication of workers in the production process and the social and organisational conditions that assure its long-term viability.

Notes

1. The late 1980s represents a significant exception, when the effects of the bubble economy have saturated the production capabilities of Toyota, generating a major crisis of its productive model (Berggren, 1995; Shimizu, 1995; 1999).
2. These ratios refer to 2004 for both plants (elaborated from TMUK, 2004; TMMF, 2001–2004)
3. The questionnaire (Toyota Shop Stewards and Amalgamated Engineering and Electrical Union members questionnaire, 2001) has been sent by mail through the AEEU office of Derby to the 10 workers' representatives elected in the shop floor shops (two are elected in the office shop). It counted 21 questions organised in four sections.

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