Transforming Kaizen at Toyota

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1. Introduction

One of the widely held opinions about Japanese firms' high performance suggests that Japanese employees, organized in teams, are making improvements in their own jobs through quality circles or other initiatives such as a suggestion system. These kaizen (continuous improvement) activities have been considered in the Western industrial world as a principal factor in Japanese firms' high product quality and productivity. This opinion was surely diffused by Japanese authors such as Masaaki Imai (Imai, 1986), Yasuhiro Monden (Monden, 1985), and strengthened by IMVP's research synthesis (Womack, Roos, and Jones, 1990).[1] Moreover the importance of employees' kaizen activities has also been emphasized by Japanese firms themselves when they are promoting these activities in their transplants in USA and in Europe (see, for example, the "Foreword" to JHRA (1995), written by a manager of Toyota Motor Manufacturing USA). Consequently, it is comprehendible that European and American automobile producers have tried to set in place kaizen activities in order to assure high product quality, and if possible, to increase their productivity, by involving workers in these activities[2].

However, Parker and Slaughter (1988), after studying Japanese transplants and American plants, underlines that kaizen is focused upon increase in productivity and imposed as such to workers. These authors then characterize the Japanese style factory management as "management by stress". If the workers were continuously compelled to increase their productivity by kaizen, they would always be under a stress. Furthermore, increase in productivity means for them a risk of loosing their job as far as their employment is not guaranteed. This fear would have a reality in the countries where the labor market is flexible to such an extent that workers and/or union present their hostility against the kaizen.

Discrepancy in understanding kaizen is then considerable. Does kaizen mainly target quality improvement or productivity improvement? Without choosing a side, it is easy to show both have some truth, but lack a global view of kaizen activities for

highlighting one side. In order to seize the whole framework of kaizen, we have to legitimately question whether these opinions confirm to what it is that Japanese employees do in this regard in their Japanese plants. First of all, who are these employees? They would have to be blue-collar workers in the Western perception, but the part of their contribution in improving productivity and price cost does not seem exceed 10% of all improvements obtained[3]. If it is not far from the reality, who then brings about the major increase in these improvements? Second, are the kaizen activities carried out without having relation to the company's profit strategy? It is hard to imagine that completely voluntary activities give increasing productivity leading to constantly reducing costs. If the employees have an objective in their kaizen activities, who provides the objectives, what do these objectives consist of, and how they are managed? These questions invite us to inquire about a whole management system of kaizen that exists in Japanese manufacturing companies. After then, it will become easy to understand the reason why Japanese transplants emphasize the importance of workers' kaizen activities through small groups and/or a suggestion system.

But then questioning the kaizen management in this way ought to reach the diversity in practices because of more or less firm specific management method. We can not say Japanese carmakers exercise the same management, even though they all have quality circles and kaizen activities, but rather the difference in their management seems to give that in their cost and productivity performance. So in this paper, I take the case of Toyota as a representative example of kaizen management because it had the most systematic and strongest cost management under which kaizen activities were organized. IMVP's "Lean Production" (Womack, Roos, and Jones, 1990) was modeled mainly based upon the Toyota Production System (TPS), but this dimension of TPS has been neglected whereas it constituted the essential of TPS. Why "had" and "constituted"? This is because an institutional change in its cost management system occurred at the beginning of 1990th.

For this reason, this text firstly presents the relationship between TPS and kaizen we can read through representative English literature in order to show our problematic (chapter 2), which calls for understanding of Toyota's cost management as its main framework of kaizen activities (chapter 3). Our concerns will be especially focussed upon production efficiency management that is relevant to the organization of work and labor cost reduction. Thirdly, it explain Toyota's new production efficiency management after making clear the problems of the old system arising in the phase of "bubble economy" (chapter 4). And lastly, it shows new kaizen activities oriented toward ergonomics by taking up the case of Tahara No.1 plant as an example (chapter 5). Through these sections, I emphasize the role of organized kaizen activities that group leaders, chief leaders and engineers are carrying out, and also the fact that their

activities are centered not only upon productivity increases but also, and more significantly, upon the humanization of work after the modification of the cost management system. In conclusion, I discuss the reason why Japanese transplants emphasize the importance of workers' kaizen activities through small groups and/or a suggestion system, and not that of kaizen made by supervisory staff and engineers.

2. Kaizen in TPS

The famous TPS cannot be reduced to its organizational techniques of production such as “just-in-time” and “Jidôka” (making machine tools and production lines autonomous, that is, they stop automatically when an anomaly occurs). Its essence resides in the method of keeping up and reducing production costs as well as improving product quality. This method is called “kaizen”.

In the literature that mentions kaizen is often emphasized small group activity such as quality circles and/or suggestions made by individual workers. Wormack, Roos, and Jones (1990), which diffused the notion of “Lean Production” through the industrial world, treats the kaizen carried out by quality circles as if all improvement of assembly line was realized by quality circles organized by working team, surely though in cooperation with shop engineers. In the bible of TPS (Ohno, 1978), which explains kaizen methods to increase productivity and product quality, Taiichi Ohno does not talk about the management of kaizen activities. Monden (1985) also have a tendency to reduce kaizen activities to those of quality circles.

On the contrary, Masaaki Imai and Paul Adler mention the kaizen carried out by supervisory staff and engineers. Imai (1986), though generalizing the notion of kaizen, gives the fact that there exist three levels of kaizen activities and a division of labor among them, i.e., kaizen made by shop managers and engineers, by small groups such as quality circle, and by individual workers through a suggestion system. About NUMMI, Adler (1998) also does not forget to note down the co-existence of bottom-up mechanisms and of top-down mechanisms in kaizen. However, Imai as a consultant of kaizen is giving the priority of kaizen to the quality improvement made by small groups and individual workers, though emphasizing a compatibility of quality improvement and cost reduction (Imai, 1997). For him, increase in productivity must be the fallout of quality improvement, which reduces repairing workers and time as well as makes “*muda*” (wastes of human resource, materials and time) disappeared, so that he neglects kaizen directly aiming at increasing productivity such as Parker and Slaughter (1988) shed light on. Adler (1998) also does not enter the top-down mechanisms because NUMMI is giving the importance rather to the bottom-up process. How ever, if almost 50% of supervisory staff's tasks were spent for kaizen (Imai, 1986), and if nearly 90%

of kaizen realized were come from them and engineers, we should understand this top-down mechanism and their kaizen activities.

In this regard, Monden (1995) explains Toyota's cost reduction management starting from “target costing” in the product development phase and carrying through to “kaizen costing” in the production phase. As far as it concerns us, “kaizen costing” has to constitute the kaizen norm imposed upon employees, but he does not explain kaizen activities organized under this “kaizen costing”. In this respect, only Japanese literature on industrial relations is available: Masami Nomura (Nomura, 1993) makes clear the management of production efficiency doing with a part of employees' wage, which compels supervisory staff to be engaged in kaizen activities for increasing productivity.[4] But he odes not show the relationship between cost management and kaizen activities. These two studies are surely complementary, if we find the way which organize kaizen under the cost management.

Consequently, in contrast with the stereotyped opinion about kaizen at Japanese firms, there are two kinds of kaizen activities at Toyota: kaizen made by the supervisory staff and engineers as their functions, and that made by workers through the quality circles and suggestion system. The latter is well known in the Western world as worker's voluntary activities that bring high quality, while a essential part of economic gains realized by kaizen — cost reduction and productivity increase — comes from the former with regards to the cost management. This paper then aims to explain the conventions in the kaizen activities organized under the cost management system at Toyota Motor Co., without neglecting of course the role of worker’s voluntary kaizen activities.

However Toyota’s cost management met radical changes at the beginning of 1990s after being kept essentially the same for almost forty years. As Shimizu (1995a, b) shows, it was a matter of production efficiency management related to labor cost. In the phase of the economic boom (the so-called bubble economy) during 1987-1991, Toyota in addition to other Japanese carmakers encountered a labor crisis – labor shortage and an aging work force. The necessity to make the work attractive in order to employ a younger labor force including high school graduated girls and to enable workers over forty years old to work on the assembly line led Toyota’s management to modify and rationalize its production and human resources management. Concerning the production efficiency management, unilateral control made by top management was altered for autonomous control at the level of factories. The constraints imposed by rigid just-in-time principles of production were loosened as a new-segmented assembly line saw the introduction of buffers. Ergonomics measures were often systematically pursued. The wage system in which the weight of production allowance became so heavy (60% of standard wage without overtime payment) was rationalized so as to be

more equitable and comprehensible for employees. Professional training was also systematized in order to give workers a more interesting working environment, and so on. All these measures taken by management turned towards a humanization of work that evokes the Scandinavian system (see Sandberg, 1995) although Toyota pursued its own distinctive path in this regard. However it follows at least that the "Lean Production" is not the promised land in the twenty-first century contrary to the thesis of Wormack, Roos and Jones (1990) (see Shimizu, 1999, and also Freyssenet, Mair, Shimizu, Volpato, 1998; Boyer, Charron, Jürgens, Tolliday, 1998; Durand, Stewart, Castillo, 1998). As a result, even if TPS always remains Toyota's method to reduce cost, the way to bring this system about, has been radically modified. To show the importance of the change in Toyota's cost and kaizen management, we have to start to look over the relationship between cost management and kaizen activities, observed until the end of 1980s.

3. The Nature of Traditional Kaizen Activities

The TPS can be understood as a set of systematized ways to reduce the cost per vehicle. These cost reduction activities start from the product design stage. After that, the management sets a reference cost of each of the parts and a standard time for their production. Then the shop floor that produces these parts and vehicles firstly endeavors to attain these costs and standard time, and then reduces them by carrying on kaizen activities. It is the group leaders, chief leaders and engineers whose responsibility it is to execute these activities. These activities and the kaizen gains are supervised and controlled by management. Thus we call these kaizen activities "organized kaizen activities". For this reason, it is important to understand the framework in which kaizen activities are organized, and accordingly, we start with an explanation of Toyota's cost management system (Figure 1).

3.1. Target Costing in the Design Stage

Toyota's product design had been conducted by a product manager or a chief engineer (Shusa) who organizes the design engineers who in turn belong to Product Engineering Design Sections in his/her team in order to realize his/her concept of a new or revised car. As is well known, this type of organization is called a "matrix organization". Moreover, it is also called "concurrent engineering" or "simultaneous engineering" because first-tier suppliers, production engineers and Production Division already take part in this design phase. Though the "matrix organization" has been replaced by four Product Development Centers regime at the beginning of 1990s, and

development term (lead time) has been shorten by using 3D-CAD and virtual production system, no changes were observed in the target costing in the design stage. In addition, the emphasis is on target costing more than ever for the reason we will see in the next chapter. Therefore, we have to have a quick look at a “target costing” which then sets a “kaizen costing” for Production Divisions (see Figure 2, and for the explanation in detail of "target costing", see Monden, 1995 and Tanaka, 1993).

When a development of a new or revised vehicle is decided, its sales price and target (or desired) profit per vehicle are fixed by the top management that takes into consideration of the market price and new car’s features that the Sales Division proposed based upon marketing and consumer analysis. As a result, the desired cost per vehicle is given automatically. This cost is called the “target cost” , because it has to be attained firstly in the product design phase and then in the production process where this model and its parts will be produced. After setting the target cost, the target costing is launched under the control of Cost Management Council (or Target Costing Council).

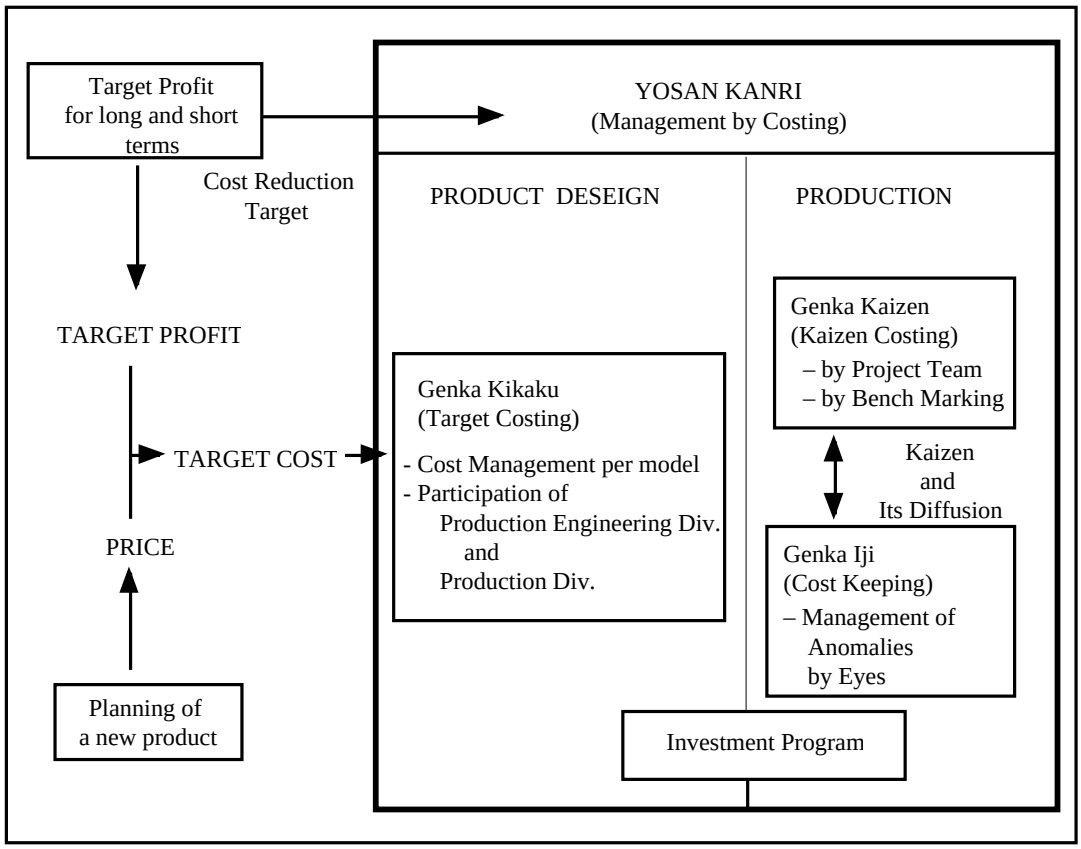

Figure 1. Cost Management System at Toyota

Source: Toyota

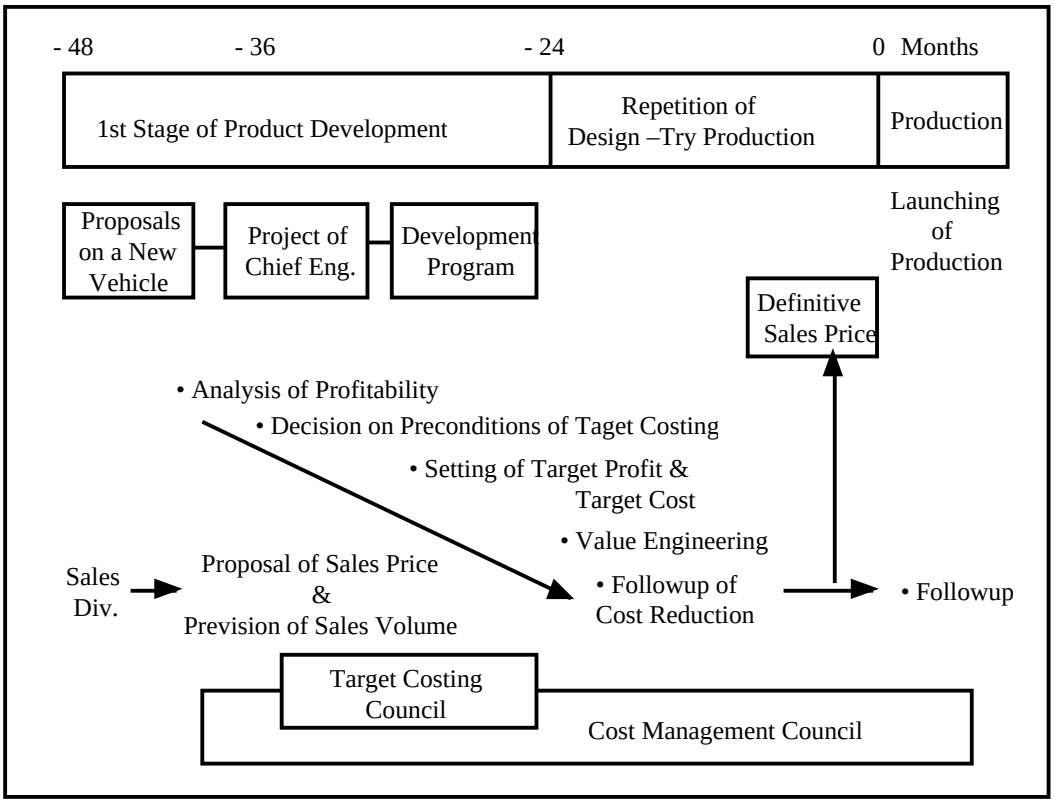

Figure 2: Procedure of Target Costing
Source: Toyota

In the design stage, begun after the product manager fixes his product planning, the target costing is organized so that the design engineers draw the parts and components of this vehicle so as to meet the target cost, ensuring of course their required quality. Following Toyota conventions, the cycle of drawing parts and production trials is repeated three times (but only one time from the end of the 1990s) before the definitive designs that satisfy the target cost and quality criteria are fixed (this process is called “value engineering”). Each time they draw the parts in this process, cost management personnel calculates the cost of the parts, in order to verify whether or not the “target cost” is achieved. Then the cost realized by definitive drawing becomes the referential cost of the product. Meanwhile, the Production Engineering Division, which conceives and prepares the production lines of parts and the final assembly line subject to investment budget constraints, fixes the “standard time” for producing parts and a whole vehicle. In other words, every production line has its own referential cost and standard time.

3.2. Cost Management in the Production Stage

The cost management in the production phase starts after mass production has begun. Firstly, these costs and standard times are not always met in production lines at least for the first few months, because workers are not used to working in the new system, and also because installations often break down. At Toyota, the learning effects seem to appear almost three months after the launch of new production. If the referential cost is not reached despite learning effects, then kaizen activities in order to reduce the cost or new drawings will be tried. Secondly, when the target profit for each vehicle is not realized efforts have to be devoted on the one hand to increasing sales and on the other to cost reduction. In these two cases, kaizen activities for cost reduction are imperative. But, even when referential cost and "standard time" are satisfied, the kaizen activities are pursued in factories not only for keeping the referential cost and "standard time" but also for reducing them further. Here exists an original feature of Toyota's cost management. Although this management was altered at the beginning of 1990s (see the next section), we explain here the cost management that existed until the end of the 1980s.

At Toyota, the costs to be managed in the Production Divisions consist of materials (including purchased parts, tools and energy) costs and labor cost, which were controlled in a different way.

The former was supervised by the Cost Council organized at every hierarchical level in the company, i.e. from top management to the shop floor (working group managed as the smallest unit) passing through Production Division, section levels (Ka), sub-section levels. The top management fixed the sum to reduce by kaizen (the kaizen costing) following its profit strategy, then distributed it as a kaizen norm to all Production Divisions taking into consideration their feasibility. In a Production Division, the allocated sum was shared out among work groups passing through sections and sub-sections. The responsibility of this kaizen belonged to the director of the Production Division, but a Cost Council was held every month and at every hierarchical level in order to manage kaizen results as well as to discuss the various measures that might have to be taken.

By contrast with the management of materials costs, that of labor cost was very complex until the end of 1980s. Firstly, it was not this cost but production efficiency that had been managed, given the fact that the labor cost was calculated on the basis of production efficiency. Secondly, it was only the Production Allowance Council organized in the top management that was watching over and controlled the movement of production efficiency. Thirdly, the management of this latter was related to the production allowance that constituted an important part of the monthly standard wage of workers (almost 60% at the end of 1980s). Therefore, we have to explain this production efficiency management taking notice of the fact that it was kaizen activities

organized by this management that brought Toyota a high performance in cost and quality competitiveness.

3.3. Production Efficiency Management and Production Reward

In its simplified formula, the production efficiency means the inverse of the ratio of the real working hours necessary to produce the products within their standard time:

$$\text{Production Efficiency} = \frac{\sum (\text{Standard Time}) \times (\text{Production Volume})}{\text{Real Working Hours of Working Group}}$$

This efficiency was calculated per each working group and every month. Here, the production volume contained only the products without defect. When products were defective and necessitated repairs, their production efficiency fell in part for the sake of a decrease of production volume in a given time, and in part because the real working hours became long for a given production volume. Therefore, the workers had to assure the quality of products in their operations in order to keep or increase the production efficiency. Prolongation of real working hours happened always also as workers stop their production line when they had problems in their operations such as existence of defective parts or when their operations were delayed with respect to cycle time – allocated time for executing a series of elementary operations. When defective parts were found, the problem was notified to their supplier whose engineers were then asked to verify and solve the problem. When the production line stopped for others reasons, it forced supervisory staff to revise standard tasks after verifying whether this delay had arisen from an inadequate organization of tasks. In this case, kaizen activities would be launched for improving the working process in question or the organization of tasks of a whole production line. In fact, the line stop system was conceived by Taiichi Ohno so as to improve the production line in precisely this way. This system served and serves still as a means to look for bottlenecks in the production line. By dissolving them, production efficiency can be increased. Of course, supervisory staff always pursues these kaizen activities.

Moreover, the Production Allowance Council and the Production Management Division, which was in charge of the production efficiency, were supervising the movement of production efficiency of all working groups. The Figure 3 shows the actual system for the evaluation of production efficiency, but it is not far from the system we are assessing here.

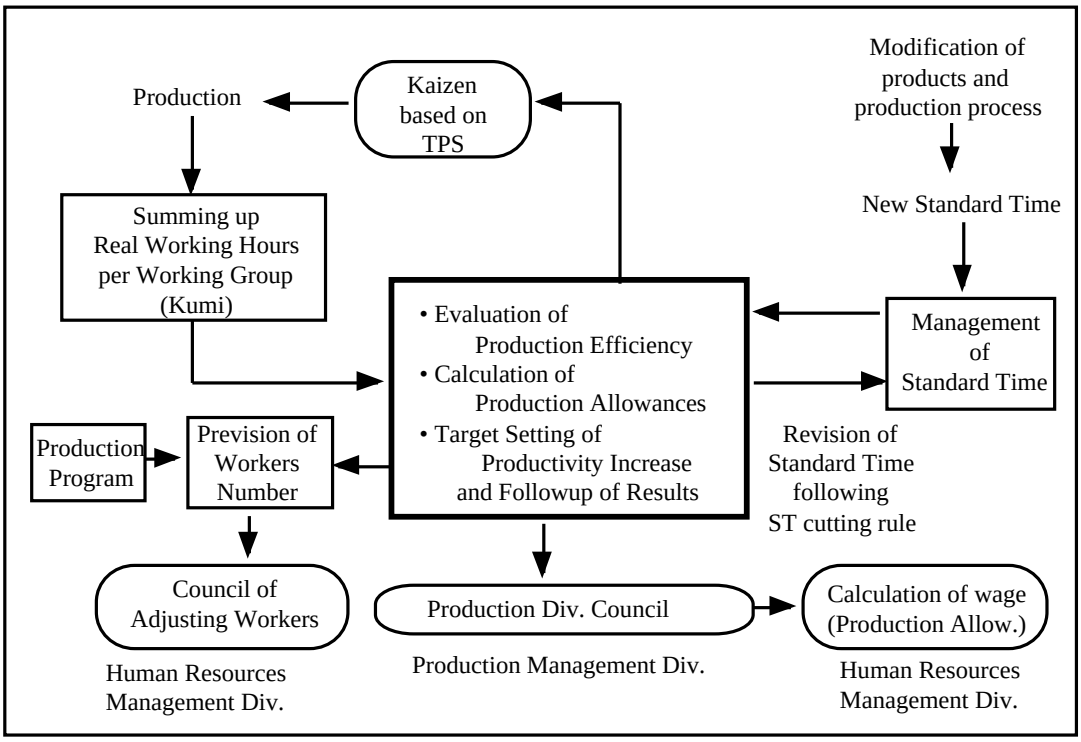

Figure 3: Toyota's System of Production Efficiency Evaluation
Source: Toyota

Toyota's wage formula for all employees until the beginning of the 1990s is given as below if we neglect various parts such as family allowance:

Monthly wage = BW (1 + PAC) (1 + OPC)

Where BW is the basic wage of each worker, PAC represents the production allowance coefficient for a working unit (sub-section), and OPC the overtime payment coefficient. Although the PAC was determined in a very complex way, we examine here only that pertaining to blue-collar workers in Production Divisions (the detail of Toyota's wage system in this epoch is explained by Nomura, 1993).

After adjusting the PE (production efficiency) in order to round off its fluctuations from month to month, this adjusted PE of all working units was ranked and classified into four levels A, B, C and D from top to bottom. Then the PAC was calculated as the average of the PEs within each level. If a working unit was classified at a higher level, its workers received a higher production allowance equal to their BW multiplied by PAC. It means then that the gains obtained by productivity increase were shared between the company and the employees.

There was, however, a rule for cutting the standard times of the working units that marked the adjusted PE higher than the average PE of the best level A. Their

standard time was reduced so that their PE would achieve this average PE. This was called the “standard time cutting rule”. Our story does not end here. At the same time, management ordered the working units in question to reduce workers. If they did nothing in order to increase their production efficiency, they would be classified in an inferior level in the next month. Because of this convention, they were compelled to make kaizen in order to improve their production efficiency so as to reach at least the same production efficiency as before with a reduced number of workers. In any case, it was difficult for a working unit to always remain in the top level. Once classified in the top level, its rank fell to an inferior level due to the standard time cutting rule, so that this working group was going to carry out kaizen activities so as to be classified once more in the top level after several months or years. Thus, a kaizen-production efficiency-production allowance chain was established (Figure 4). As all working units were doing the same thing, their average PE had a tendency to increase (Figure 5). This gave in turn the augmentation of PAC as time passed.

In addition, by fixing an objective for increasing production efficiency every six months, the Production Allowance Council occasionally ordered the working units whose production efficiency always remained low to make kaizen. Alternatively, it imposed a kaizen norm on all working units when the company faced a difficulty such as the period of the first oil shock in 1974 or that of the fast appreciation of yen in 1985-87. Thus, the increase of production efficiency by kaizen constituted the core of the TPS. However, this production efficiency management has been altered for the sake of a labor crisis at the end of 1980s (see the next chapter).

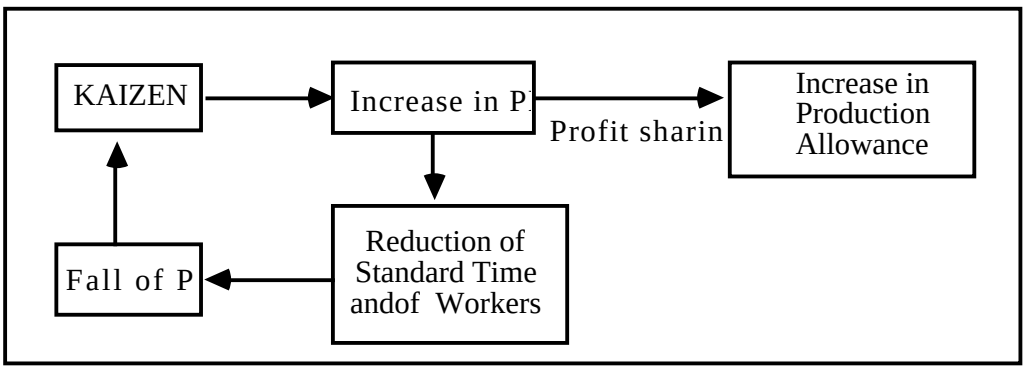

Figure 4. The relationship between Kaizen, PE and PR
Source: Shimizu, 1995a

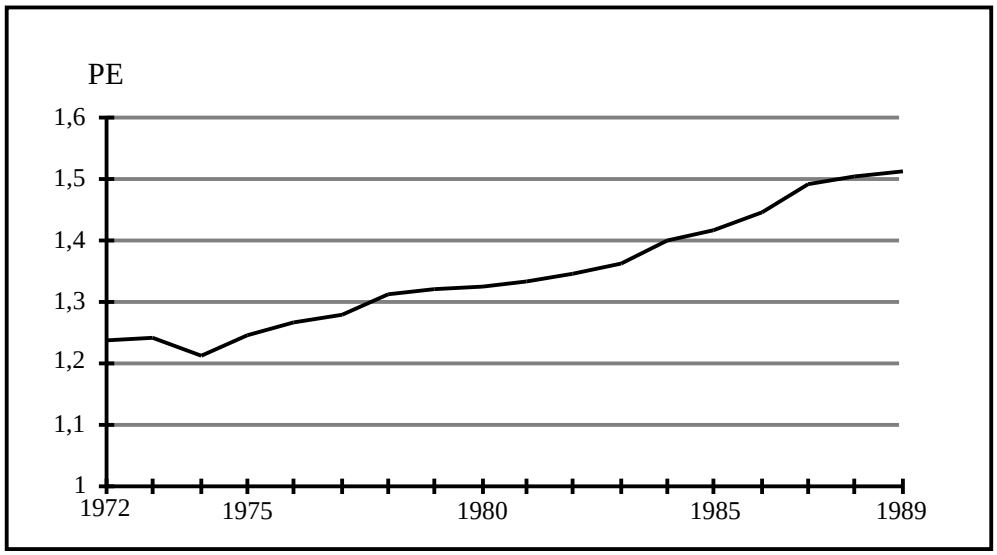

Figure 5. Movement of Average Production Allowance Coefficient
Source: Shimizu, 1999a

3.4. Kaizen organized

As we saw above, kaizen for increasing production efficiency, thus for lowering labor cost never was and is the matter of worker's voluntary activities. It was controlled under Kaizen Costing management and Production Efficiency Management. About this kind of kaizen, there was and is a division of labor amongst group leaders, chief leaders (sub-section leader, or working unit leader), and engineers, although shop managers (section chiefs) in a plant are promoters and coordinate the activities made by them (see Table 1 for the grade system at Toyota).

– The group leaders are mainly in charge of reducing the cycle time of their workers by improving their operation process. It of course contributes to the contraction of the real working hours of their group, and after all to shortening the standard times. In fact, establishment of standard work and standard time is their main function. In order to do this kaizen, the line stop system is useful for sorting out problems to solve, but also they often form an autonomous study group in which they discuss problems and the various measures necessary to solve them.

– The chief leaders engage themselves too in shortening the standard times of their working unit, but this occurs by means of process improvements for reducing the workers in their unit. In general, the reduction of workers from production line, called "Shôjinka" at Toyota (see Ohno, 1988, and Monden, 1985), constitutes an important method at Toyota for increasing production efficiency as well as for decreasing labor costs. They also take charge of the real working hours reduction by process

improvements over several working units. For this purpose, they also organize occasionally an autonomous study group including often their supervisory staff.

<table>
<tr><th colspan="2">Job Title (A&E)</th><th colspan="2">Grade</th><th>Rank</th><th colspan="2">Job Title (Production)</th></tr>
<tr><td>Project Position</td><td>Managerial Position</td><td>Administrative & Engineering Staff</td><td>Production Staff</td><td></td><td>Managerial Position</td><td>Expert Position</td></tr>
<tr><td rowspan="3">Project General Manager</td><td>Divisional General Manager</td><td colspan="2">Senior General Manager</td><td>AA</td><td colspan="2" rowspan="2"></td></tr>
<tr><td rowspan="2"></td><td colspan="2">Senior Grade 1</td><td>1A</td></tr>
<tr><td>Department G.M.</td><td colspan="2">Senior Grade 2</td><td>1B</td><td>Deputy G. M.</td><td>Project G. M.</td></tr>
<tr><td>Project Manager</td><td rowspan="2">Staff Leader</td><td colspan="2">Senior Grade 3</td><td>20</td><td>Manager</td><td>Project M.</td></tr>
<tr><td>Assistant Manager</td><td>Assistant Manager</td><td>CX</td><td>30</td><td>Chief Leader</td><td>Chief Expert</td></tr>
<tr><td colspan="2" rowspan="8">Staff</td><td>[40]</td><td>–</td><td>40</td><td colspan="2"></td></tr>
<tr><td>[50]</td><td>SX</td><td>50</td><td>Group Leader</td><td>Senior Expert</td></tr>
<tr><td>[60]</td><td>EX1</td><td>60</td><td rowspan="2">–
(Team Leader)</td><td rowspan="2">Expert</td></tr>
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<tr><td colspan="2">[9B]</td><td>9B</td></tr>
<tr><td colspan="2">[9C]</td><td>9C</td></tr>
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Table 1: Grade System and Job Title at Toyota

Source: Toyota

Note: The grade system of Toyota changed during the 1990s. As far as our discussion is concerned, we should take note of the fact that “team leader“ as a job title was eliminated around 1997, and replaced by “Expert” who is not responsible for executing any management function.

– The engineers belonging to a plant are in charge of maintaining and improving the quality of products, productivity, cost and security of work from an engineering view point. In general, capital-labor substitution constitutes the main way of reducing workers. An installation of new equipment is made during the reconstruction of production and assembly lines at the time of launching a revised vehicle. In this case, they play the role of intermediaries between shop floor and the Production Engineering Division, which is ultimately responsible for implementing change. Also, as their usual activities, they conceive a mechanical solution for the bottlenecks in production lines,

discussing problems with group leaders and chief leaders, which they cannot solve with their ordinary methods as we saw above. At Toyota, however, the replacement of workers by machines has to be done after improving the operation process for the sake of rigidity of machines as well as under the budget constraint.

Besides these main actors involved in kaizen, a maintenance team contributes to increasing the reliability of equipment mainly by executing preventive maintenance and equipment kaizen. This of course contributes to contracting real working hours by reducing line stops caused by machine breakdown. A kaizen group makes tools and machines as required by the shop floor. Searching for bottlenecks and measures to take is not their task. In assembly factories there exists also a “try team” consisted of skilled workers of group leader level and team leader level (the position of team leader was done away with around 1997). The main task of this team is in verifying facility of and measuring time necessary for installing parts in a car body by “trying production” of a new or revised car before launching its mass production. However, the “try team” in some assembly factories is doing kaizen activities of assembly line in close cooperation with engineers belonging to their factory.

As we saw above, it is mainly the group leaders, chief leaders and engineers who are carrying out kaizen activities concerning the production efficiency, the quality of products and the working security as their ordinary function. These kaizen activities were under the production efficiency and cost management until the end of 1980s. In this sense, we can call it “organized kaizen activities”.

How about worker’s voluntary kaizen activities, then? Occasionally, some workers suggest an important and remarkable idea about quality improvements or working process improvements. In general, however, and from the viewpoint of management, their activities themselves have their own meaning other than the improvement of production efficiency and the reduction of production costs. Thinking about their working place and environment and the quality of their products is itself important. It serves as a training of their kaizen mind and ability, that is, looking for problems in their work place, searching measures to take and solving problems. In the case of quality circles, a worker becomes its leader in rotation and discusses with the other members about the problem he/she or they set. It forms his/her communication capacity and leadership as well as their cooperation mind. The importance is given here to forming their “kaizen mind” and “teamwork” (in Toyota’s sense, it means cooperation among company’s members). These voluntary activities also allow workers to give attention in their operations to product quality, productivity, costs and security. By carrying out kaizen activities through quality circles or the suggestion system even if they can not realize an important kaizen from economic viewpoint, workers are eventually able to obtain the abilities required for becoming supervisory staff, given the

fact that supervisory staff is selected from workers. For these reasons, the emphasis is on the activities themselves.

After all, it was organized kaizen under control of production efficiency management and cost management that constituted the source of Toyota's high performance for more than thirty years. Especially we have to remember the fact that the reduction of standard time and workers by organized kaizen was at the center of the TPS for reducing cost and increasing productivity. However, it was this management that was called into question around 1990.

4. Modifying Traditional Kaizen Management

During the "bubble economy" in 1987-1991, demand for cars was overheated, accelerating the diversification of car models including different model variations with high quality. All carmakers then augmented their sales. Their profit, however, did not increase as rapidly as their sales, while some of them constructed a new assembly plant in order to respond to the increasing demand. Despite the economic boom, these strategies became a burden on their profitability. Furthermore, the "bubble economy" provoked a crisis of work, that is, labor force shortage, because being able easily to get a high wage job, new labor market entrants, who have a tendency to decrease due to a declining birth rate, avoided heavy manufacturing work. So, carmakers began to improve assembly lines with a slogan "human friendly assembly line" or to install "silver lines" where aged workers could work. Some of them also pushed automation when they constructed new plants (Kyushu plant for Nissan, Hofu Plant for Mazda, Tahara No.4 plant for Toyota). At the same time, Toyota was engaged in a radical revision to its production management and human resources management in order to solve this labor crisis. Taking the labor shortage for a long term phenomenon, Toyota also decided to change working conditions so that high school graduated female workers and aged workers over forty years old may be willing to work there.

4.1. Crisis of Work and the Necessity to Make Work More Attractive

Facing the labor crisis, in 1990 Toyota's union and management formed a Committee in which their representatives called into question the production efficiency management coupled with production allowance, the human resources management, the working conditions and the tough assembly line work (see Shimizu, 1995a, 1998, 1999a). Convinced of the necessity of making work more attractive for solving the labor crisis, Toyota then decided to radically modify its production system.

The reason for this revision resided in the very characteristics of the TPS itself. As we explained, the way to increase productivity or production efficiency was by reducing the number of workers by kaizening the production process for a given production volume under the constraints of "just-in-time" production. Without saying that it intensified work, the factories had a tendency to run with a minimum number of workers. In stable economic growth, this system was running very well, but it could not meet the explosive demand of the "bubble economy". With diversification of parts and increased production volume, workers were heavily loaded so that many young workers left Toyota. For example, one quarter of newly hired young workers left Toyota during their first year in 1990. For solving the labor shortage thus provoked, Toyota employed a huge number of temporary workers (their ratio in the direct workers reached more than 10%) mainly assigned to assembly plants that consisted of, in general, a stamping shop, a welding shop, a paint shop and a assembly shop. In some working groups, they occupied three quarters of workers. With a lack of normal trained workers and with increased temporary workers who had not sufficient ability to execute complex tasks on Toyota's assembly lines on which various car models with diversified parts were assembled, the production line was often interrupted. Group leaders and chief leaders then had to intervene on the line in order to solve problems. As a result, annual working hours were prolonged (2, 315 hours in 1990) although productivity fell remarkably (see Figure 6). Even the group leaders and chief leaders were exhausted, and the labor shortage turned out to be a crisis of collective working – as a human factor in the TPS.

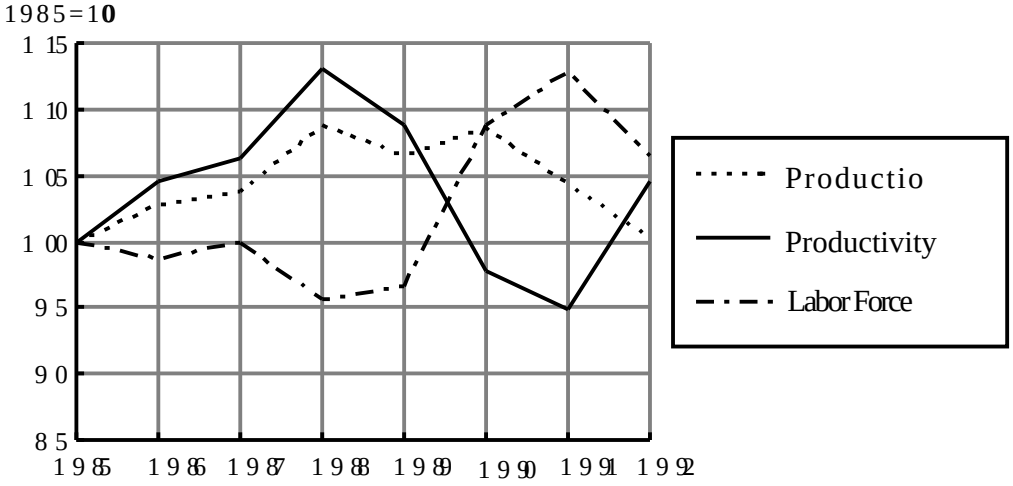

Figure 6. Production, Productivity and Labor Force in the Period from 1985 to 1992

Source: Shimizu, 1999a

Note: Productivity represents that of direct workers including logistic workers in the plants (labor force). All indices were calculated on the basis of Toyota's data.

In such a confusion, traditional production efficiency management as well as the rigid application of just-in-time production, which means one by one production without buffers in its ideal model following Taiichi Ohno, was put into question.

4.2. New Production Efficiency Management and the Wage System

In the Committee, management promised the union not to push too much cost reduction by increasing the production efficiency or reducing workers. Rather the promise was to make more effort for cutting the costs of materials and parts in the product design stage much more than before. At the same time, management realized the modification of production efficiency management.

First of all, the management renounced its unilateral. The objective of production efficiency improvement henceforth has not been imposed within the plants every semester by the top management (Production Allowance Council). Now, plants themselves set their annual objective of production efficiency increase, while the Production Allowance Council has been replaced by the Production Divisions Council (see Figure 3). In general, it is a manager (section chief) who has to establish his/her section's objective. Then the plant director (administrator in general) arranges the objectives coming from the sections he/she manages. The Production Division Council that checks the objective presented by the plants occasionally modifies this, taking accounts of company's profit strategy. After the approval of the various objectives thus adjusted, these become a kaizen norm of each plant in terms of production efficiency. Thus, the kaizen for increasing production efficiency has become autonomous. However, there is a problem: which criterion can the plant refer to, in order to establish its own objective? In the case of a plant on which I have carried out observations, this objective was 3% for the year 1996. This ratio represents the share of labor cost in the production cost.

Secondly, the method of determining the production efficiency was altered to become less constrained.

– It is now permitted to take into consideration the working segments where young female workers and older workers are working, whereas the standard time had been determined by a "try team", then by skilled male workers.

– The standard time had been fixed on the basis of the best standard time marked in the past, while it is now fixed by measuring the time really required for worker's operations three months after launching mass production.

– Concerning actual working hours, management decided after negotiation with the union to reduce the long annual working hours. After a planned reduction by 300 hours of annual working hours for three years from 1991 to 1993, a successive two

shifts work without night shift (6:30–15:15 and 16:15–1:00) was set in place in 1995, following after Toyota Kyushu (subsidiary of Toyota at Kyushu – see Shimizu, 1995a). The latter helped to reduce considerably long overtime work. Management and the union also encouraged employees to consume all paid holidays, while they had discouraged them to do so in order to keep the attendance rate high.

Thirdly, the method of calculating the production allowance, now called "productivity allowance", was altered for blue-collar workers and simply abolished for white-collar workers. After a minor change in wage system in 1990, which introduced a grade allowance (GA, 10% of standard wage) and an age allowance (AA, 10%) by reducing the share of production allowance from 60% to 40%, Toyota radically changed its wage system in 1993. It now has two systems, one for blue-collar workers and one for white-collar workers (their AA is going to be abolished in April):

For blue-collar workers,
Standard wage = BW (40%) + GA (20%) + AA (20%) + PA (20%);
And for white-collar workers,
Standard wage = BW (40%) + GA (40%) + AA (20%).

The reason for which the production allowance had been paid to white-collar workers is that by doing so, Taiichi Ohno wanted to manage their overtime, because the latter had the effect of lowering the production efficiency of the company as a whole and then to augment the total labor cost. The union could not criticize this system under the authority of Ohnoism, although white-collar workers felt it was strange. On the contrary, the productivity allowance continues to be paid to blue-collar workers. This is because the union itself recognizes it as a remuneration of workers' efforts to increase productivity (production efficiency). As we mentioned before, the production allowance can be interpreted as a share of profits realized through kaizen.

However the calculation of productivity allowance was changed so as to be reasonable and equitable.

- Production efficiency is determined in respect of the activities of all workers in the working sections that include direct workers, workers of kaizen groups and those of maintenance teams. Previously, only direct workers had been considered in this category. It is because all these workers contribute to increasing productivity.

- The production efficiencies are classified by a group of homogeneous factories: a group for foundries, forges, stamping and sheet metal shops, a group for mechanical components, a group for body welding, painting and plastic molding, and an assembly group. It is because there is a difference in mechanization level among theses groups, which affects the production efficiency. Within a group, the production efficiency of all

sections are classified into three levels A, B, C from top to bottom, in order to determine their production allowance coefficient as mentioned before (see section 1.3).

- Productivity allowance coefficient is however applied to the sum fixed for each worker's grade (hierarchical rank), and not to the individualized basic wage as in the past. All workers of the same grade in the section now receive the same productivity allowance. It has thus become clearly an allowance given as a remuneration of the result of collective production.

- Although the share of productivity allowance in the standard wage was reduced from 40% to 20%, the width of its variations was retained. Then, the character of production allowance as a shared profit realized by kaizen and workers efforts has been kept in this new system.

After all, this change in the production efficiency management coupled with the wage systems, undertaken during in the first half of 1990s, is remarkable in itself when we note the fact that the production efficiency management remained untouchable for the union from the beginning of 1950s until 1993. In fact, the management gives the plants an autonomy in kaizen activities even for increasing productivity, and surely this gives them more responsibility for cost management. Thus, the framework of cost management remains unchanged, but the way to bring into play this management has been fundamentally altered. It also means that giving a high motivation to employees is indispensable so that this kind of management is fruitful.

4.3. Kaizen for Making Assembly Work More Attractive

With the cost management, the way to work on the assembly line was revised in order to get down the high turnover rate, and also so that young female workers and aged workers, who had been transferred to an indirect section, are willing to work there. On the basis of discussions held in the Committee and also in the Assembly Directors Council, the Production Engineering Division developed a new concept of assembly line and work organization. After trying an automatization of assembly line when the Tahara No.4 plant was constructed, this new concept was realized in the Toyota Kyushu's assembly line (cf., Shimizu, 1995a, b; Ogasawara and Ueda, 1997; Nohara, 1998).

– An assembly line is divided into about ten segments per function (eleven in the case of Toyota Kyushu). It is permitted to have a buffer between two segments, the buffer corresponding to five minutes operations. Thus, when a segment is stopped because of a problem, the others continue to work. So, the production efficiency of the assembly line as a whole does not get lower, and the line stop system does not oblige the workers to work as much overtime as in the past, because the loss of time provoked

by stopping a segment can be absorbed by the buffer. This means loosening the just-in-time rule under which having any buffer in the production line had been regarded as sin. The stress workers had been feeling when they stopped the line was relaxed. So, it became easy for workers to assure quality in their working place.

– Moreover, a working group is operating in a segment where its group leader has a greater power on his/her work organization than before. Then, the group leader is allowed to stop the segment during the time their buffer permits in order to examine a problem to solve (this is called “planned stop”), whereas the right to this kind of line stop belonged only to the manager (section chief). In this way, working groups have now a certain degree of autonomy on their organization of work. For example, at Toyota Kyushu, a group can hold a meeting during working hours in order to do kaizen activities so far as this meeting does not disturb the others, i.e. so far as the buffer allows. Each segment also has a quality checking post so that not only a worker but also a working group as a whole can assure quality.

– For making the work less loaded, an ergonomic method developed by the Production Engineering Division (TVAL – Toyota Verification of Assembly Line) is applied to measure the load of all operations. All operations, of which TVAL value is higher than a certain level, are considered as too heavy operations, and then dissolved. This method gives Toyota’s Criteria on Hygiene and Security following which the production process is now being improved. On the basis of this method, many ergonomic means have been taken in order to make assembly work so easier that even young female workers and aged workers may work there. For example, a large conveyer installed on the ground level permit workers to operate, standing on it and without walking much with a car body moving, and especially without walking backward. Tasks to carry heavy parts also disappeared by installing automatic or semi-automatic equipment, though automatization was not pursued because of its rigidity.

This assembly line concept was realized when reconstructing old assembly lines. After Toyota Kyushu, it was applied to Motomachi No.2 plant (1994), Tahara No.1 plant (1995), and Motomachi No.1 plant (1996) in Japan and to new Kentucky No.2 plant (1994) in U.S.A. These reconstructed assembly lines are not the same as that at Toyota Kyushu because of difference in their factory space and of budget constraints (Japan has been in the long depression from 1991). It has to be remembered that Toyota is now giving an importance to improving assembly work or to “humanizing” assembly work. This means also that the work in the past, at least until the end of 1980s, was so heavy that new generations of workers were unable to sustain it even with higher wages. Of course, the female workers and aged workers were regarded as being unable to work there. So, we can say the labor shortage led Toyota to radically revise its factory management. As a result, kaizen toward humanized work is now systematically pursued.

This new orientation of kaizen activities, going with the modification of production efficiency management, provoked a remarkable repercussion, as we see below.

5. A Case Study of New Kaizen Activities at Tahara No.1 Plant

As we mentioned above, the assembly line at Tahara No.1 plant was reorganized in 1995 clearly following the new concept realized first at Toyota Kyushu. However it was the assembly section itself that conceived this new assembly line, taking the initiative in product design and reconstruction of the assembly line.

It began in 1991 where the revision in 1995 of the Hilux Surf (sports utility) being assembled and the assembly of another sports utility (Land Cruiser Prado) from 1996 were planned. On the basis of discussions held in the Committee above mentioned, the director of this assembly plant suggested to his assembly section's manager (section chief) to prepare the revision of this sports utility by searching for an ideal assembly line. He then started to conceive it and organize engineers, "try team" staff, chief leaders and group leaders so that everyone would collaborate in order to realize an ideal assembly line about which he did not however have any clear conception. Then he fixed the orientation toward the reconstruction of his assembly line as follows:

- Construct an assembly shop where the workers can work easily and execute their operations "rhythmically";
- Organize a human centered Toyota Production System;
- Form a kaizen mind of everyone so that he/she willingly does kaizen.

The section chief thought that if the assembly shop were organized in such a way, it would also contribute to increase production efficiency assuring quality and security, and then to reduce costs. There were many problems to solve, which necessitated the collaboration of the product manager of these models, Product Engineering Design Sections, Production Engineering Division as well as those of Araco and Hino (Araco designs the body of Land Cruiser Prado; Hino, that of Hilux Surf whereas Toyota develops their chassis). In fact, the conception of new assembly line could not be developed without modifying vehicle structures and parts designs of these models.

5.1. Organizing a "Teamwork" amongst Group Leaders, Chief Leaders and Engineers

First of all, the section chief had to convince the engineers belonging to this plant, chief leaders and group leaders as they would construct by themselves their own assembly line in collaboration amongst them.

First, he persuaded the engineers who in turn persuaded the members of the "try team" which consisted of supervisor level employees (group leaders and team leaders). It was these people who verified two vehicle structures and their parts in order to make proposals for modifying parts designs and the vehicle structures to product managers, Product Engineering Design Sections, Araco and Hino. They also examined the whole assembly line and made clear all problems to solve following the criteria given by their section chief.

Then, he discussed with all chief leaders one by one in order to persuade them of his idea, because they had to be main actors in the kaizen of working process. After convincing them, he organized their meeting for learning the way of thinking about just-in-time, "Jidôka", reduction of workers by kaizen, standard task and standard time, Kanban system, logistics, kaizen of working process, calculation of production efficiency and of productivity allowance, method of kaizen and so called "operation in the fixed-zone" which means that a worker finishes a series of elementary operations within a given working zone. This meeting was held every month for six hours as a whole, having a monthly subject to discuss. The same meeting was organized for the group leaders and for team leaders. In these meetings, the emphasis was on forming their attitude and way of thinking that the section chief demanded. Holding these meetings, he succeeded in motivating them to construct their own assembly line or to make kaizen for this purpose.

Along with these meetings, an autonomous study group was organized respectively by chief leaders as well as by group leaders. The chief leaders group was carrying on kaizen of production processes over several working groups in order to eliminate a worker from a shift for example or to realize "operation in the fixed-zones", etc., while group leaders group was engaged in improving workers tasks or working processes taking up one of the posts in their working group every month. All these activities were discussed in the groups so that they would share the know-how and problems.

Thus, good cooperative relations amongst engineers, chief leaders and group leaders were set into place in this assembly plant. This "teamwork", of which an engineer is "proud" in comparison with other plants, enabled them to carry out the construction of the new assembly line, and to make kaizen toward humanized work even after the launching mass production.

5.2. Value Engineering Suggestions

In order to construct an ideal assembly line, the difference in assembly time of Hilux Surf and Land Cruiser Prado had to be dissolved. The fact that this difference

was almost one hundred minutes (258 minutes for Hilux Surf against 356 minutes for Land Cruiser Prado) made it impossible to assemble them on the same line. Accordingly, the assembly section decided to make proposals for modifying the structures of these vehicles so that they could have similar structures, as well as of using the same parts as much as possible. In order to do this these propositions had to be accepted by the product managers of these models and also by Product Engineering Design Sections, Araco and Hino at the very beginning of product design phase. That was in 1992.

After analyzing old models and comparing their structures and parts, this plant presented VE suggestions (value engineering suggestions) over two hundred points to Product Engineering Design Sections, and after all, about one hundred-fifty suggestions were accepted and realized by the latter. As a result, the difference in assembly time of the two vehicles has dissipated: now the assembly time is 259 minutes for Hilux Surf and 254 minutes for Land Cruiser Prado.

The participation of the assembly section in product design process at such an early stage and the VE suggestions made are themselves very exceptional and amazing. In general, Production Division concerns itself with the product design process when trying to assemble a new designed car begins in order to verify the facility of its assembly and the quality of new parts. In this case, the Production Division is used to demand modification of parts design to Product Engineering Design Sections. However VE suggestions were never proposed before the first design was drawn.

It then shows the high technical level of supervisor level workers of the “try team” (team leaders and group leaders) as well as that of engineers belonging to the plant. The former can receive technical training in collaboration with engineers, i.e. on the job training. Every supervisor experiences a “try team” in rotation so that their technical level gets higher.

After Tahara No.1 plant's experience, this new direction of plant's participation in product development begins to diffuse through the other plants. As a consequence, Toyota's concurrent engineering are modified so that such a plant's participation contributes to shorten the product development term by making clear the problems of old vehicles at the very beginning of product development.

5.3. Constructing an Ideal Assembly Line

The reconstruction of the assembly line began already in 1991 under budget constraints and without production stoppages.

The annual budget of a plant is managed by the Production Council in the top management, whereas the budget for reconstruction of assembly line at the time of

vehicle revision, more important than the former, is decided by the Cost Council. Though Tahara No.1 plant planned the reconstruction over four years, it could not receive a sufficient annual budget for this operation. By using the manager's budget, usually spent for making human relations activities, besides its normal annual budget, by receiving a financial help from the other plants at Tahara, and by making money by carrying out kaizen for reducing cost (which gives the plant an increase of manager's budget), this plant realized the reorganization of assembly line with almost 70% of planned budgets in four years (5 billion yens). This means that the assembly section could not make luxury investments to realize an "ideal assembly line" as in Toyota Kyushu plant, but tried to do it in an economic way.

Under such budgetary constraints, two existing assembly lines had to be reorganized into only one assembly line divided into ten segments. The emphasis was laid on the humanization of work according to the orientations initially set by the section chief. That is, the assembly line has to be

- Without any operation difficult to execute,
- Easy to assure the quality,
- Assuring worker's security,
- With efficient logistic,
- Able to assemble a vehicle in a time as short as possible,
- Assembling a vehicle with low cost,
- Having high investment returns.

For this purpose, the first thing the section chief wanted was to optimize the height of car body in order that workers could execute their operations without taking a difficult and hard physical posture. To decide the optimal height of assembly line, variable depending on working posts, engineers examined all tasks. Making work three workers of different height – a tall worker (176 cm), an average worker (170 cm) and a small worker (162 cm) – at each post so that they could work taking their best posture, the engineers determined the best height of vehicle body in each working post. On the basis of these criteria, adjustment of the assembly line height began in 1992.

These heights were not realized exactly, because it was necessary to level them off in order to constructing the assembly line. Consequently, particular measures were taken so that each worker could take a best working posture. At the end of 1992, 85% of working posts were then already adjusted by construction work, made in weekend by subcontractors, and the rest was done at the time of the ordinary reconstruction of assembly line for launching a revised vehicle in 1995.

Secondly, the "try team" conducted by engineers examined every task in order to verify whether it corresponded with the criteria proposed by the section chief. About the tasks that had problems, they classified these tasks in three groups:

– The group where problems had to be solved by modification of parts design, so that they presented VE suggestions to Production Engineering Design Sections as we saw above;
– The group where problems could be dissipated by installation of equipment and which would be realized by using the annual budget or the budget for vehicle revision;
– The group where problems could be solved by improving working processes and/or equipment.

From 1992 until August 1994, the chief leaders and group leaders carried out kaizen to improve working processes, whereas a kaizen team took care of improvements to existing equipment and also of the realization of some of the installations. A large part of the new equipment was subcontracted to machine makers internally and externally. From September 1994, mainly the chief leaders in collaboration with engineers prepared the way for the reorganization of two assembly lines into one line, and this work started in May 1995 and was completed in November 1995.

Along with the activities of chief leaders and group leaders, maintenance teams were improving the reliability of equipment in collaboration with engineers, while a logistic team ameliorated the logistic system in the plant in order to assure security, for example by eliminating forklifts from the shop floors, as well as to increase efficiency in the parts supply.

Although our explanation of the construction of assembly line at Tahara No.1 plant is not exhaustive (for the detail, see Shimizu, 1999b), it follows at least that kaizen is not only dedicated to the cost reduction and especially to the increase of production efficiency, but also to the elimination of hard works. Kaizen for improving productivity and reducing labor costs is always pursued in all plants as we saw before, but at Tahara No.1 plant, this kind of kaizen has to be made after achieving the kaizen for humanizing works. In fact, following the guideline engineers established in order to improve working processes during the reconstruction of the assembly line, the former has to be made after satisfying the latter because the priority of kaizen is focussed upon the humanization of work. As the improvement of assembly line corresponding to the "ideal" did not terminate at the time of the reconstruction, chief leaders and group leaders have continued to do kaizen after launching mass production of the revised vehicles.

At this point, we have to make a remark. This experiment coincides completely with the discussions held in the Committee for making the work more attractive. However, we have to say that as far as we know the case of Tahara No.1 plant was unique even at Toyota. In fact, it was the Production Engineering Division that

conceived a new assembly line at Motomachi No.1 and No.2 plants. Also, kaizen activities in other plans were not organized as systematically as at Tahara No.1 plant. However, others began to share this experience, even if they cannot take the same initiative for constructing their assembly line as at Tahara No.1 plant[5].

6. Conclusions

Toyota has been carrying out many other reorganizations from the beginning of 1990s, on office work and on Engineering Design Sections as well as on its product strategy, but changes made in its cost management and kaizen activities are the most important from the viewpoint of labor relations as well as in order to understand Toyota's labor management. In fact:

- Vector of cost management was reoriented towards cost reduction made in the product design stage more than in production stage;
- The production efficiency management was altered from the unilateral one to an autonomous one of Production Divisions;
- This is occurring together with changes in wage systems as well as in the management of working hours.

These modifications mean that after encountering the labor crisis, Toyota can not search only for the cost reduction by increasing production efficiency, but also has to advance humanization of work.

Thus, kaizen activities were reoriented for making assembly work more attractive. Here they do not refer to workers voluntary activities, but organized ones as we explained, that is, kaizen on a large scale made by engineers of the Production Engineering at the time of reconstruction of assembly line, and kaizen usually carried out in the plant by engineers, chief leaders and group leaders. In reality, the essence of the Toyota Production System resides here in the organized kaizen activities under production efficiency management. For this reason, the change in cost management is meaningful and opened the door to further kaizen initiatives. We can conclude it though by recognizing that an analysis which suggests the emergence of a new Toyotism demands the study of all changes which took place during the 1990s (see Shimizu, 1999a).

The case of kaizen realized at Tahara No.1 plant is eloquent too. It shows a new possible concurrent engineering where the Production Division takes part in the product design process at its very beginning. At least, it confirms that today, car design and conception of assembly line have to go hand in hand in order to facilitate and humanize assembly activities. This also means that an initiative taken by shop floor personnel can play an important role in concurrent engineering.

Finally, it is the time to discuss, based upon what we saw above, the kaizen activities in Toyota's transplants in USA and Europe. The main reason for which Toyota is promoting kaizen made by quality circles and individual workers through the suggestion system resides in the necessity for nourishing kaizen mind and ability of workers as well as constructing good human relations on which the TPS is based. Their kaizen activities imply four effects: paying attention to the quality and productivity, acquiring little by little kaizen and problem-solving ability, perceiving the work place as their own, and understanding the meaning of kaizen. This also says doing kaizen by themselves serves to elude a harmful "use and them" relationship at the shop floor, caused by top-down process in kaizen, especially in the countries where antagonistic relations between workers and supervisors are prevailing. Obviously, kaizen imposed provokes there workers' hostile or negative reaction against improvement of their own working process. So, it is the priority for the company to construct good human relationship among them, which workers' kaizen activities can be one of the means to involve them in. In short, the difference in industrial relations and history of Toyota and its transplants led Toyota to choose such a policy. As workers and supervisory staff accumulate their experiences, the transplants will probably set in place the same system as in Toyota's home plants. Until then, the transplants might continue to receive the technical support from their Japanese mother plant, especially in productivity improvement.

References

Adler P. (1998), “Nummi: de l'autonomie du travail à la socialisation de la production?”, in J.P. Durand, P. Stewart and J.J. Castillo (1998)

Adler P., Goldoftas B., and Levine D. (1998), “Stability and Change at NUMMI”, in R. Boyer, E. Charron, U Jürgens, and S. Tolliday (1998), *op. cit.*, pp. 128-160

Boyer R., Charron E., Jürgens U., and Tolliday S. (1998), *Between Imitation and Innovation*, Oxford University Press, London

Durand J.P., Stewart P. and Castillo J.J. (1998), *L'avenir du travail à la chaîne: Une comparaison internationale dans l'industrie automobile*, Editions la Découverte, Paris (*Teamwork in the Automobile Industry*, Macmillan, London)

Freyssenet M., Mair A., Shimizu K. and Volpato G. (1998), *One Best Way?*, Oxford University Press, London

Humphrey J. (1996), “New Manufacturing Strategies and Labour in Latin America”, in Stewart P. (1996), *op. cit.*, pp.99-116

Imai M. (1986), *Kaizen: The Key to Japan's Competitive Success*, MacGraw-Hill, New York

Imai M. (1997), *Genba Kanri: A Commonsense, Low-cost Approach to Management*, MacGraw-Hill, New York

Ishida M., Fujimura H., Hisamoto N., and Matsumura H. (1997), *Nihon no Lean Seisan Hoshiki*, Chuo Keizai Sha (in Japanese)

JHRA (Japan Human Relations Association) (1995), *Improvement Engine: Creativity & Innovation through Employee Involvement*, Productivity Press, Portland

Jürgens U., Malsch T., and Dohse K. (1993), *Breaking from Taylorism: Changing Forms of Work in the Automobile Industry*, Cambridge University Press

Monden Y. (1985), *Toyota Production System*, IIE

Monden Y. (1989), *Jidôsha Kigyo no Cost Management*, Dobunkan,Tokyo (in Japanese)

Monden Y. (1995), *Target Costing and Kaizen Costing*, Productivity Press, Portland

Nohara H. (1998), “Toyota réforme le Toyotisme”, in J.-P. Durand, P. Stewart, J.J. Castillo (1998), *op. cit.*, pp. 41-54

Nomura M. (1993), *Toyotism*, Minerva, Kyoto (in Japanese)

Ogasawara K, Ueda H. (1996), “The Changing Nature of Japanese Production Systems in the 1990s and Issues for Labour Studies,” in P. Stewart (1996.), *op. cit.*, pp. 44-59

Ogawa E. (ed.) (1994), *Toyota Seisan Hoshiki no Kenkyu*, Nihon Keizai Shinbunsha (in Japanese)

Ohno T. (1988), *Toyota Production System: Beyond Large-Scale Production*, Productivity Press, Cambridge (Japanese version, 1978)

Parker M. and Slaughter J. (1988), *Choosing Sides: Unions and the Team Concept*, A Labor Notes Book

Sandberg, Å. (ed.) (1995), *Enriching Production*, Avebury, Aldershot

Shimizu K. (1995a), “Humanization of the Production System and Work at Toyota Motor Co and Toyota Motor Kyushu,” in Å. Sandberg (1995), *op. cit.*, pp. 383-404

Shimizu K. (1995b), “Kaïzen et gestion du travail chez Toyota Motor et Toyota Motor Kyushu,” in *Actes du GERPISA*, No. 13, Université d’Evry-Val d’Essonne, pp. 13-42

Shimizu K. (1998), “A New Toyotaism?,” in M. Freyssenet, A. Mair, K. Shimizu and G. Volpato (1998), *op. cit.*, pp. 63-90

Shimizu K. (1999a), *Le toyotisme*, Collection Repères/Editions La Découverte, Paris

Shimizu K. (1999b), "'We Will Construct Our Assembly Line': the Case of the Tahara No.1 Plant of Toyota," (I) and (II), *Okayama Economic Review*, Vol. 30, No. 3, pp.125-162 and Vol. 30, No. 4, pp.303-331 (in Japanese)

Stewart P. (ed.) (1996), *Beyond Japanese Management: The End of Modern Times?*, Frank Cass, London

Tanaka, T. (1993), "Target Costing at Toyota," *Journal of Cost Management*, Spring, pp. 4-11

Wormack J.P., Roos D., and Jones D.T. (1990), *The Machine that changed the World*, Macmillan

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[1] Of course, there existed firms such as Ford and Renault who were aware of the importance of kaizen activities carried by small groups before the publication of these books. These early attempts did not however bring their fruits as expected, but constituted learning process in planting small group activities in factories. See in this regard chapters 9 and 14 in Freyssenet, Mair, Shimizu and Volpato (1998).

[2] The reality of the so-called "Japanization" of factory management in the automobile industry is shown by the GEPISA international network's systematic studies, whose results are published in Freyssenet, Mair, Shimizu, Volpato (1998), Boyer, Charron, Jürgens, Tolliday (1998), and Durand, Stewart and Castillo (1998).

[3] This rate comes from a rough impression one of the managers at Toyota gave us. Eiji Ogawa (Ogawa, 1994: p. 244) also shows the same figure.

[4] After Nomura (1993) follows Mitsuo Ishida's study (Ishida, Fujimura, Hisamoto and Matsumura, 1997, chapter 1), based on his interviews with managers at T plant of Toyota.

[5] For example, Toyota's oldest assembly plant at Motomachi began to train its plant engineers from 1998 as they can conceive its assembly line by themselves about which its chief engineer is developing a new concept.