The inter tier reception system and Human Resource Management
— A study of the Toyota KEIRETU—

Hiroshi Gankoji
Graduate School of Business Administration
NANZAN UNIVERSITY

Introduction

The establishment of efficient and effective supply value–chain is the essential issue for lower-end major automobile manufacturers to eliminate "muri, muda, mura"[1] through supplying parts that are just needed amounts when needed, for sharpening global competitive edge. Especially, this is the indispensable issue for Japanese automotive manufacturers which depend much on outsourcing from suppliers.

This article newly adopted two more cases of t-2 suppliers in the similar product realm, for generalization of the learning that is derived from former analysis "The order reception system in KEIRETU – An actual condition at a tier 2 small firm" (Gankoji 2009). And in addition, from an angle of human resource management, this article aims to improve the analysis above including the Union participation to the non-union firms in KEIRETU.

Therefore at first from the angle of production control, this article try to disclose the way how small-size t-2 (tear 2) suppliers have handled of the order frequency from t-1 (tear 1) suppliers. Also, this article analyses the working system and labor management that supports such flexible production system. Second, this article analyses the mutual relationship for symbiosis between t-1 and t-2 suppliers which are consisting vertical supplier chain.

When check proceeding articles, there are very few systematic sturdy that focuses on the t-2 suppliers and also very few approaches from an actual shop-management systems or labor management those are the base of the flexible order reception system. And, there are almost no such effective studies after e-KANBAN system[2] which is adopted by Toyota at the end of 1990's'.

Totsuka,Hyodo(1991) intended to analyze the flexibility of the order dealing and labor management system. However, the domain of this sturdy is limited to major automobile manufacturers, and the focus of this study was the comparison of union-activities and industrial relations that support flexibilities. As the results, this

study does not properly refer to the t-1 or t-2 suppliers. While the Japan institute of labor (1992) is remarkable, for it refers to t-3, from the stand point of hierarchy of labor market, but it lucks on the analysis of an actual work-place as the hierarchy of the flexible order reception system, which has defined the labor management.

Ueda(1992,1993) verified the framework of industrial relations and union activities at union-organized t-1 suppliers as the basic condition for flexible auto-manufacturing system. However, it did not refer to the relations with the flexibility of production adjustment at each tear of manufacturing structure.

Also Totsuka=Hyodo(1991), The Japan Institute of Labor(1992), Ueda(1992,1993) restrict those study realm to the union-organized farms. As the result, those studies did not aim to percept the flexible auto-manufacturing, labor management and laborl relations systematically at small-size manufacturers where generally union is not organized. Also, there are almost no such preceding studies.

For systematical comprehension of production adjustment and shop management, this study focused on 3 companies which consists Toyota manufacturing division at t-2 rank. Also for efficiency of study, this study narrows it's realm to small or middle size stumping manufactures.

Attention to the relationship between labor and management at shop floor as the fundamental factor of the labor relations, and this study does not stick to the unionized shop, but observes simply shop floor relationship between labor and management as an actual labor management relationship even at unorganized shop.

Out line of the company V is below. And the profile of each supplier is shown at the section in concerned.

Products; Drive-train, rigs, etc.

Results: Fiscal year 2007 sales 270 billion yen, Recurring profit 18,63 billion yen (consolidated)

Employees; 73,500 (consolidated 2007 FY. end)

Before investigation into the actual conditions, at first, establish a hypothesis, which is brought out the various techniques for production adjustment developed through the practice of Toyota Production System. Then, in the course of verifying the possibilities of adoption to small size factory management, this study find out and analyze logical necessity of device and related hardship just like small production site. And finally, this study aims to clear labor management that turn out flexible working system unique at small size shop management.

Section 1. Hypothesis on normal adjustment system of production or manpower level.

At first, as the view point of study, establish the hypothesis and arrange study issues for adoption of TPS (Toyota Production System) techniques on the production and work force adjustment according to the requests from t-1 or assembly maker.

(1) The order announcement and it's adjustment system

T-1 or assembly maker should issue unofficial announcement of procurement amount at next month and succeeded 1-2 months for supporting HEIJYUNKA[3] production scheme at supplier. This is for procurement cost reduction through increasing productivity at suppliers.

Of course, production line has a function of minor adjustment, however, though within the unofficial announcement sometimes production level changes unexpectedly by the pick up KANBAN[4] according to the rate of operation at the following tier company. If it is the reasonable range, such fluctuation can be adjusted by minor modification of tact-time. But if it were excessive level, that is to be adjusted through in ten-days or a month.

In this case, through average the order level, assembler or t-1 supplier is required to make easy for t-2 suppliers to receive order fluctuation with HEIJYUNKA method. This means that unevenness of production is averaged with wider range of term based on the capacity of manpower or facility at former tier suppliers. To do so, former tier suppliers can avoid impacts on production or, if it were transient, can evade from the risk of holding excessive manpower or facilities.

How are the unofficial announcements instructed by assembler or t-1 suppliers? And how have the adjustments executed between owners and suppliers? What kind of adjustment process is set in-house or out side of suppliers?

(2) The system of production adjustment in-house of suppliers

In case of the change that is able to adjust at daily-base, suppliers can execute adjustment effectively with fewer muri, muda, mura, by setting up reasonable tact-time[5] and realizing HEIJYUNKA process with each parts number.

That is to say, at first tact-time is calculated, the daily production time is divided by the scheduled daily amounts of parts product at each line, then process order is combined with the required amounts of each parts-product, finally, all kind of parts-product are processed with HEIJYUNNKA method. If the parts variety were so wide, through a tact-time operation for each parts number, production line is operated constantly with reasonable manpower and facilities.

Surely it seems efficient, because a definite amount lot production at a time require fewer set-up time[6], but in case of parts variety are complicated and each has it's exclusive specifications, idle and busy time are repeated at the latter process. At the same time, former process has to prepare excessive equipment (or procurement) to prevent missing parts. Like this, production efficiency as a whole, including former process, is decline significantly. Of course, even if the processes those need large scale set-up time like stamping process, HEIJYUNKA production is realized simply through to picking-up amount from the latter process with efforts for minimizing the lot size and set-up time.

Again, each parts number requires exclusive processing, workers skills, and operating process. However in such cases, it is possible to set up tact-time at each operating process, and father more, through continuous flow processing by binding common line, it may more efficiently correspond to production waving with tact-time.

Each production process is combined like a chain. This suggests the importance of production adjustment with tact-time method. Especially, such sense may be required for forefront managerial posts. Either in house or out sourcing, bad influence of collective lot production impose former process excessive equipment and manpower also impose latter process the risk of line stop by missing parts. But if a frequent pick-up is executed with scheduled quantity (unscheduled time) conveyance[7], it may be possible to reduce stock product in process.

Just as hypothesis above, how far the production adjustment with HEIJYUNKA method is adopted and implemented at supplier's shop floor? And how much extend can it be get ahead at the suppliers that the finished products are picked-up with frequent conveyance at scheduled quantity unscheduled time, and that the stock level is reduced at the same time the synchronization with t-1 suppliers and t-2 supplier's processes are closed? Or is there another original adjustment method, just like small-size farm, that has taken place of the HEIJYUNKA systems? In such cases, from the angle of management, what are the necessity and supremacy?

（3）Manpower Planning and it's management

Based on the hypothesis about the production adjustment according to the order frequency above, the hypothesis on the way of manpower adjustment, especially the system by forefront managers and the type of employee participation, should be established.

The manpower planning is set in fiscal year based on a long-term production or profit planning. On the monthly planning, the manpower balance is realized based on the

required manpower of each line or shop including flexible transference between line or shop based on monthly production planning and unofficial announcement. If necessary, at the mid of the month, monthly planning should be reviewed, on the change of a monthly or pick-up level by t-1 suppliers.

Of course, if the HEIJYUNKA production is executed, required manpower is set on tact-time (given by daily production amount needed into total scheduled time worked) and improvement in productivity. However, it's not enough.

From the angle of quantity, at first the situations such as using level of annual paid holiday, work load (level of overtime work), managerial post in-line worked, planning of promotion to managerial post, manpower adjustment over line or shop, the proportion of non-regular worker, forecast on retirement, long-term leave, the restriction of task, and productivities, should be considered. After this, additional manpower adjustment over line or shop should be considered. How far is these close adjustment executed actually?

Second, the angle of quality, the theme that should be considered by managerial post is to set-up manpower mix that can realize the performance on standardized work combination table at given tact-time. The required skill levels are very different at each task in process, from initial to supreme rank, this is why the reasonable allocation of worker is critical issue for the managerial posts in the sense of assurance quality and cost. So the managerial posts have to set rules for development of multi skills, the wider band of tasks, and the flexible manpower allocation.

Though regular workers is increasing at small size firms, there are no such shop conditions as large scale manufacturers where regular employees are majority and enough skill base is established in house. By contraries, they should try to coordinate various type of recruitment and working style, and should realize flexible adjustment, while clear the level of product quality, cost, delivery requested. What kind of worry and devise are prepared to clear such very different issues?

If an unexpected big change of production level has happened, normal type of adjustment method may not be available. In such case, as the short term adjustment, such method is adopted as decrease the number of non-regular workers or manpower transfer over line or shop temporarily while reduction of overtime work level, change of shift pattern including night shift and Sunday. As the long term adjustment method, the reasonable executive decision is required on fare personnel allocation, with review of equipment planning or routing change.

Of course, executive priority should be set on the stability of employment, and whether on regular or non regular employees, the adjustment scale must be

minimized.

Third the angle of quality, the first priority is to disclose the rule of personnel adjustment and to warranty on it's fare execution, and to make great effort for improvement of mutual-understanding and persuading from all employees including non-regular workers.

How does the personnel adjustment rule is announced to shop floor and whether the mutual-understanding from employees are confirmed?

Are the sufficient explanation and communication executed in advance by forefront managerial post or plant executives at shop floor level?

Another, in the course of adjustment, for increasing the performance, shop-floor initiative should be strengthen. For this, both leadership of managerial post and identification as a team or motivation of each employee at shop floor should be strengthened. How these efforts are approached?

Finally, in the course of adjustment above, those should not be neglected are the continuous efforts for skill improvement and development of manufacturing product, because those are the most important theme that promise future competitiveness.

The skill should be improved by OJT method through experiences of disorder or trouble at an actual shop floor. Both mutual trust between superior or senior and subordinate and the reliance on company's policy produced through close activities for mutual understanding are the indispensable circumstance for skill formation on the shop floor. How such skill development is executed at shop floor? Just like small size firms, where many non-regular employees are working, what kind of devices are adopted for skill formation?

（4） The function of the trade union

From the angle of labor relations, What is expected to the trade union is the role of so-called "counter part" function for the executive operation. However, at small size firms, it is impractical to appoint union executives working full time. As the result, union leaders are subjected to great hardship because they shoulder a responsibility as lower–level managerial post at the same time as the union executive.

However, if the solid relationship on equal term with each other is deepened, it dedicates to increase of the security of living and employee's identification with their company, also expected accurate monitoring check to executive operation. In this sense, establishment of the solid relationship on equal term above is the most serious theme of labor management and union organization policy. Further more, establishment of the solid labor relation at small size firms is not only highly positioned for the All

Toyota Workers Union (ATWU), which organizes assembly maker and t-1 suppliers of Toyota group, to strength it's solidarity and to rise the minimum of labor conditions, but also, to take an essential role of labor risk management at each tier in KEIRETU that are the base of production division, because whole processes including t-1 and t-2 suppliers are synchronized with pick-up KANBAN and if labor dispute were happened at any suppliers it's influence would be spreading all that synchronized network.

Related above, the ATWU released in 1988 "the guide book on the production fluctuation" to all the affiliated unions, and in 1992 after revised this, issued "the guide book to establish the work rule on the production fluctuation". With this booklet, the ATWU has suggested to all the affiliated unions that they have to establish or to improve the work rule comfortably and to execute fair implementation. Also, the task force set up in the headquarter of the ATWU, named "Business Management Policy Committee (BMPC)", which has reported for affiliated unions "the guiding principle for adjustment of work condition by production fluctuation", and the outline reported are as follows.

(The ground rule of stance)

As the group, first priority is to set on making a religion of work and to refuse unreasonable work condition, and each union has to negotiate with management through the collaboration for a solid development.

(As the affiliated unions)

Each union executive should place out the actual work conditions periodically, and talk with management for improvement. At the same time, pay enough attention to result in worse influence at other related unions.

(As the ATWU-headquarter)

On the periodic survey and report by affiliated unions, the ATWU headquarter has to inspect actual adjustment operations for production fluctuation at affiliated unions. When it were impossible to resolve through in-house negotiation at affiliate, the head quarter should take charge of the issue, positioned as the common political issue of Toyota supplier chain.

How have the union executives, employee representatives, or labor management executive participate in the process of manpower adjustment listed above, and what kind of role do they carry out? And what kind of stance for activities the ATWU has taken in and has carried out the role for affiliated unions? Especially for fair and reasonable manpower adjustment, how has the headquarter participate in the

activities at affiliated unions.

In the section 2, according to the sense of issues above, each hypothesis is verified through the study on the actual condition of 3 cases, and the manpower adjustment system for the production fluctuation should be disclosed. Also flexibility of manpower adjustment just like small size farm and labor management system as the base of such flexibility should be analyzed. And finally in the section 3, this article aims to study the role of t-2 suppliers that has constitute the base of production division and to clear the reasonable relationship between t-2 suppliers and t-1 or assembly maker.

Section 2. Case Study

The 3 companies which are the object of this study have manufactured stamping parts. However, the processes are somewhat different with each other according to the product. The specific process of the company A is roll-forming, the company B is wire-cable rod processing, and the company C is precision press forming. The adjustment system of each specific or common factors are disclosed below.

(1) Company A[8]

① The Profile of A

The company A was established in 1960. Total employees are 352 as of CY.2007 end (Domestic affiliates 5 total 515 as of CY.2005). There are 2 manufacturing affiliates, and 2 service affiliates. And there are 2 production sites at US. and China(the People's Republic of China). This company supply products to Toyota group and other4 automobile manufacturing group. This company is placed t-2 on the division ladder of automotive manufacturing in Toyota KEIRETU because principal customer is t-1 supplier of Toyota.

The company A has urged all employees to associate the movement named "Innovation of this company with the 6 angle MIERUKA, visualization". The meaning of this movement is to emerge from the subcontractor consciousness that is to say "production just as instructed", instead improve product quality and develop original skills or techniques.

The core approach is named "3 committee's activity", and in this process, top executives by themselves verify monthly the results brought about by employee's efforts on the field of quality, safety & production maintenance at actual shop floor with an approach named "GENCHI GENBUTU[9]".

The aims of this approach are to cultivate executive's talent, development brilliant

technologies, and cultivate the tough production site. As the part of this approach, the company A has introduced Toyota Production System since 15 years before, and also acquired ISO9000 and ISO14000. Especially as to the implementation of Toyota Production System, this company has established engineering service office, and consequence 15 years, top executives and the engineering service staff have collaborated to implement the system. At present, as the "voluntary study", they have aimed to improve one theme a month. Now 84 themes are on the move. In this process, the president and executives execute leadership in solving problems at each shop floor, and have accumulated the know-how for improvement based on GENCH-GENBUTU.

The financial results are favorable, for the sales are increasing continuously, and unconsolidated sales (FY.2007) are twice as much compared with that of 10 fiscal years ago.

Main products are parts around doors, and with cold roll forming almost no other company come closes to this company in quality & technical supremacy, especially the production amounts of vertical plate of door frame is 1.5 million sets (compete 1st position in the world), and are supplied to 4 major automotive manufacturing groups.

Also, company A is the excellent company which is nominated as "the brand of manufacturer" by Chamber of Commerce and Industry, and is recognized by governor as "the Aichi-brand company with the recommendation of Aichi industry and labor bureau.

② The device of process for flexible order reception

The object of this study is the main plant of company A, there are 3 types of products, Which are vertical plate of door frame, seat rail, and seat slide, are manufactured, and those products are supplied to the company V with pick-up KANBAN. KANBAN (delivery) cycle[10] is the frequent conveyance with 1-8-4 KANBAN pattern

The cold roll forming is the process of a plastic working of panel, which produces panel products with cross sectional design panel from flat panel by gradual and successive side stress through the process of tandem roll line. Technically compared with stumping process, this process is dominant in the molding of precision parts made from high–tension panel. However initial investment must be larger than the similar stamping equipments.

It has been 10 more years ago when high–tension panel was adopted. Forecasting the demand for the higher quality of automobile, this company has determined the prior investment on the processing of vertical plate of door frame and seat rail which require higher precision.

The strategic efficiency of the decision has brought high reputation at market place.

The stance of respect for the production quality is not only cold roll forming. For example of bending process, this company has not adopted hemming but original developed stamping process with flexible combination die system and has realized higher precision.

After molding in the basic shape, and via small size stampings line, products are processing by each parts number. In this stamping process the lot size has reduced through the reduction of set up time by 1 to 6 minutes. In further details, an off-line set up system is adopted, which has made use of the die insert dolly with lift adjustment function at the side of stumping machines. After the required die is picked up from the die stock shelf and an off-line set up operation has done, not with hoist but with the roller the die is implanted on a bolster sliding guided by the rail. Like this, die replacement and set up is completed effectively. In this set-up operation, through location blocks are set at counter side of bolster. This system has made the measuring of dimension much easier and positioning time is shortened dramatically. These devises must be largely dedicated to a shortening of set up time.

At the stamping process of small size products, according to the principle of Toyota Production System, the management of cycle of machine operation and that of work are strictly separated. Many processes are adjacent with each other and consisted U-shape arrangement, which aims to realize the process-flow and the multi-process handling[11]. Those devices make easier to select 2 or 3 personnel shift flexible to variation of production quantity at parts number level.

The accumulation of those devices with Toyota production measures above realizes 8 times per 1 day frequent conveyance of each parts number according to the pick up KANBAN as mentioned above.

Another point worthy of special mention on the personnel management is that 80% of skilled worker are Brazilian. Since 1980s this company has positively employed the Brazilian worker. They work earnestly, however because of the immigration control that restricts sojourn terms, they cannot stay enough time for skill development, the company points.

Presume such personnel structure, it is the key issue for the forefront shop manager to establish powerful and tough production site.

③ The order reception system

A term of production scheme on long term base is not definite by each assembly maker, ex. 6 month base, year base, or several year base. And major owner V informs scheme on a several years base.

On the monthly scheme, in case of the company V, in the later part of the month, the

company V informs 3 month scheme, that are next N month order and N+1,N+2 month unofficial announcements at each part number base. And at the end of the month, next month final order is informed with reviewed N+1, N+2 month unofficial announcement. Thus the monthly schemes are reviewed repeatedly. The company A sited, in recent 10 years, the accuracy of the unofficial announcement is improved remarkably, and at present the range of fluctuation are within 10%, that makes easier to correspond to the variation of production.

The vertical plate of door frame, as the object of this study, is a typical product of this company, which processes are consisted from 7 roll forming equipments, and a series of stamping and assembly line where panel materials are cut at designed size and have processed to the finished product. The assembly line is consisted from 7 processes, with 4 semi-auto line and 5 manual operation line. In this process, after outer trimming, flange up, and inner hemming, to these formed panels the supplied parts from outer suppliers are welded. Then as the final process, these half-finished panel parts are transferred to the processes where 2 holes are set-up. And if necessary after alternations, they are shipping to the assemblers or t-1 suppliers.

However, few products are shipped after detailed sample inspection process which is named “200% inspection process”.

Take this vertical plate of door frame line for example, at first we should review the way of production adjustment in a long-range.

On the plant engineering, the company A has set a line-rebuild scheme by 2010 on their own based on the each company’s unofficial announcement of procurement.

According to this scheme, in CY.2006, the investments on equipments are reduced through the old type semi-auto set up equipments was improved and developed to new type. Also, in CY.2008, with newly equipped semi-auto line-forming machine the load at manual line has scheduled to be reduced. At the same time, within 5 years, a fixed cost reduction scheme has been proceeding, for example, through the most effective utilization of equipments has realized by an integration of parts production sites waving into the production level caused by product changeover, and also review the cycle time[12].

Through such reasonable and long-term plant engineering scheme, the work load should be reduced and that dedicates to the company’s profitability. There, one type of effective circulation of management is aware.

How about the application of monthly order and N & N+1 unofficial announcement?

After the company has received unofficial announcement, the rate of machine operation and manpower needed are studied on the table named “NINKU

SANTEIHYO" to manufacture the quantity needed by each parts number based on the minimum lot size and cycle time. A remarkable thing is that on the table the cost of production and sales of each part number is indicated. From the stand point of executive management, this means that those have urged to a subjective efforts at each shop where is the basic unit managed by supervisor and team leaders. Also this is positioned to be a part of "the Built-in-Quality-Activity" as mentioned later.

Thus, after set up the production and manpower schedules are reviewed based on the 2 more measures for the efficiency of machine operation and work load. In this process, from the angle of preventing excessive or of the equality of work load, both the equipment capacity (as of equipment availability per day) for producing ordered quantity of parts number at each line and the rate of machine operation are checked. Also, personnel allocation is adjusted within 2 shift 16 hours without unequal personnel arrangement including tentative transfer over several lines..

After this process, a job of individual worker is assigned. This indicates the consistent personnel adjustment policy tender to the employees as human beings. Of course, this schedule is reviewed at the time of the determination of next month order, and the accuracy of the schedule is improved the more.

As to the monthly production schedule, at first required amounts of each parts number at each line are defined based on the order shown on the next month order.

Also in order to minimize the inventory level on the safe side to prevent missing of shipping and at the same time to reduce the frequency of set up die, the best production order and the frequency of set up at each shift are scheduled based on the capacity of palette (minimum lot size). This process is named "lot formation".

And on the production schedule set above, the needed time (total work time including direct work time such as the cycle time as the net working time, set up time, repair time, plant maintenance time and indirect work, etc.) are calculated, then manpower needed and individual worker's allocated to the each process are fixed.

Although like other stumping manufacturers, the company A does not adopt "real time lot formation" according to the pick up KANBAN.

One of the reason of this is that the order of each part varies extremely wide, 15 different parts number are manufactured at this vertical plate of door frame line (on the actual schedule of 10 parts number at September 2008 fixed order base, there are only one part number is 600 units per day, other 2 parts numbers are 150 and 75 each, others part numbers are all 3-5 units par day each). So considering set up times for these extremely small size units, it's almost impossible to realize real time HEIJYUNKA operation. The textbook guiding instructs that "for realizing

HEIJYUNKA operation, how much the reduction of lot size can be practiced by minimization of pallet size, and for realize this, such as the reduction of set up time, the difference with net working time and total needed time can be reduced with frequent set up operation". However, it may be very difficult to implement such know haw in these actual manufacturing conditions above.

Generally speaking, under such extremely wide-varied small-unit operation, small-size unit is waving in the constant flow of mass units production schedule, properly setting up die for small lot production of such small size-unit.

Of course the set up process for small lot above impose such considerable pressure on the managerial posts in charge as to realize both lot-size reduction and ship any product following to the pick up KANBAN. The forefront shop managers are required flexible and proper decision with a well-informed on the equipment availability or the personnel allocation, because it is not promised that parts are pick up smoothly following to the monthly production schedule. In addition, except the company V, KANBAN fluctuation is comparatively large. So the shop managers may be anxious and urged to accumulate stocks as a measure of safety for preparing pick up KANBAN.

However at the company A, through continuous improvement, for example at certain process, the standard time of die set up at the company A has been reduced from 10 minutes to 60 seconds. Also, at the planning of processing order or lot organization, the slogan "planning production based on a pick up speed to realize minimum stock level" is declared. Such efforts are surely the indispensable for reduction of monthly level of work load and standard stock, also improvement of KANBAN cycle.

Then, how manage the pick up KANBN which are distributed from the company V? The pick up KANBAN those are delivered by return transport service are slit into KANBN post of each part number placed at line. After the number of KANBAN are piled up to the definite level (standard number of KANBAN), those are pick up and slit into the KANBAN shelf placed by the small-size parts stamping line, and are produced based on monthly scheduled lot manufacturing order (above). In this way, just as the quantity picked up by KANBAN is lot manufactured and filled up at supply store properly making to pick up timing.

As the "standard number of KANBAN" is determined by monthly scheduled lot size, if the pick up level variation is within an ordinary level, the daily variation of pick up level is relatively easy to manage. In this connection, by now, the company A has almost no such cases to employ temporary or non-regular workers. The reason is firstly the accuracy of monthly unofficial procurement announcement. Secondary, the KANBAN pattern 1-8-4, this may mean that 4 times delay supply pattern for a margin

to manage production level swings.

④ **The flexible manpower planning and it's management**

The hierarchy system is consisted with 4 rank, those are chief, foreman, and manager. And practically, the forefront chief is responsible to manage cost (quantity of materials to be used at an individual process), quality, and manpower planning.

The manpower planning is build on the monthly production schedule and unofficial information. The chief coordinates and establishes manpower allocation to each work place, considering properly of such factors at each shop floor as each worker's level of annual paid vacation, rate of machine operation, productivity improvement etc.

The manpower allocation, established above, is disclosed on a process chart which indicates each worker's position like bird's-eye view with each worker's photograph plate. As the result, each worker is able to aware who is in charge of which process visually. (This called "MIERUKA", visualization) This process chart with photograph is one of the ideas of visual awareness that has get over the language barrier. And at the allocation, reasonable process sharing for each worker is devised based on an individual skill chart that illustrates each worker's skill level with 4 grads.

And skill development is principally executed with OJT (On the Job Training) that is systematically operated in the work process. (This called "GENCHI GENBUTU"; any source of improvement is initiated from the shop floor and work process).

In spite of the 80% high dependent on Brazilian guest workers, why the company A saves such top-class in-process quality and suitable skill base, and what kind of system or device is set for personnel development?

For this issue, the company A has work on the activity named "self conclude job ability development" activity. At first the excellent staffs are selected, and at the cream school for future executives, top- managers and the selected members collaborate to establish 2010 vision. And the members have to accomplish by themselves. Through such "self conclude system" executives with high competency are developed. Also, for being reborn from yes-man crowd to challenging band, this "self conclude" program urges to individual worker to set up the challengeable theme at each process in charge, and establish target and clear the target by himself.

In this case, "the Built-in-Quality-Activity" program requires each employee to set items to be challenge and target to be clear which is appropriate to each employee's competence. In other words, this system is very intensive and challengeable system, because each employee is establish a commitments with the president or executives in charge and have the opportunity to take evaluations 2 times a year. In addition, it has the critical effect to urge the reform of consciousness from managers to clerks or

workers.

This “Built-in-Quality-activity” program has begun CY.2003, and the registered themes are increasing from 50 at the beginning to 168 at present. In the present themes, 34 very efficient themes are proposed mostly by the Brazilian managerial posts. And not to say, the decisive roles are performed by the chief at shop floor, the company A disclosed. For example, the work sequence sheet written by a Brazilian chief Senior D is the results of his challenge, and at the same time this implies the symptom of effects by such intentional education. Those activities involving shop floor has brought about expected high performance to the company A. Incidentally, the company A has almost annually received many awards such as cost competitiveness, quality and technological excellence. Those prizes have award to the participating suppliers by the company V.

⑤ co-understandings and communications with management and employees

Then at each level of a managerial position, from executives to forefront, how steadily are the communications executed to get enough understanding on production and manpower adjustment also executive policy, institutionally or actual base?

Any trade union nor employee’s representative system is not established at the company A. All the more, the integration or coordination of opinions at shop floor must be critical issue for encouraging fair and solid labor-management relationship.

Such responsibilities for communication above are performed by managerial posts, chief or tem leader, and any matter from shop floor is settled at the shop floor, the company say.

The factory manager presents for all employees on production adjustment, executive policies etc. once a month. In this process, for example, some chief encourage and ask his subordinates to improve productivity to clear planned quantity without overtime work considering this sever business situation. On the other hand, the company, based on the Toyota Production System, has urged to ease work load with overall methods such as continuous-flow processing, multi-skilled operations, flexible manpower management separating worker and machinery, etc.

Especially the company A has executed a positive promotion of efficient Brazilian employees, and as the results one half of the managerial posts above chief are occupied by the Brazilian. In addition, like the chief Mr. D above introduces the devices presented by his subordinates aggressively, an aggressive participation by Brazilian superiors are observed. These efforts by the efficient Brazilian managerial grades with the personnel system above have brought about the mutual understandings and reliability deepened, and that have realized such multiplier effects as a forefront

flexibility and productivity. And this must intensify so called “GENBARYOKU” at actual production sites.

Even so, why such marvelous results has created passing across the border or barrier lie down between Japanese and Brazilian? The company A explains, they does not depend on dispatched workers but has directly recruited as regular workers same as Japanese, and are carefully developed skills and implanted the spirit of a family sense of the company. This is the reason why a sense of belonging is produced cross over nationality and language.

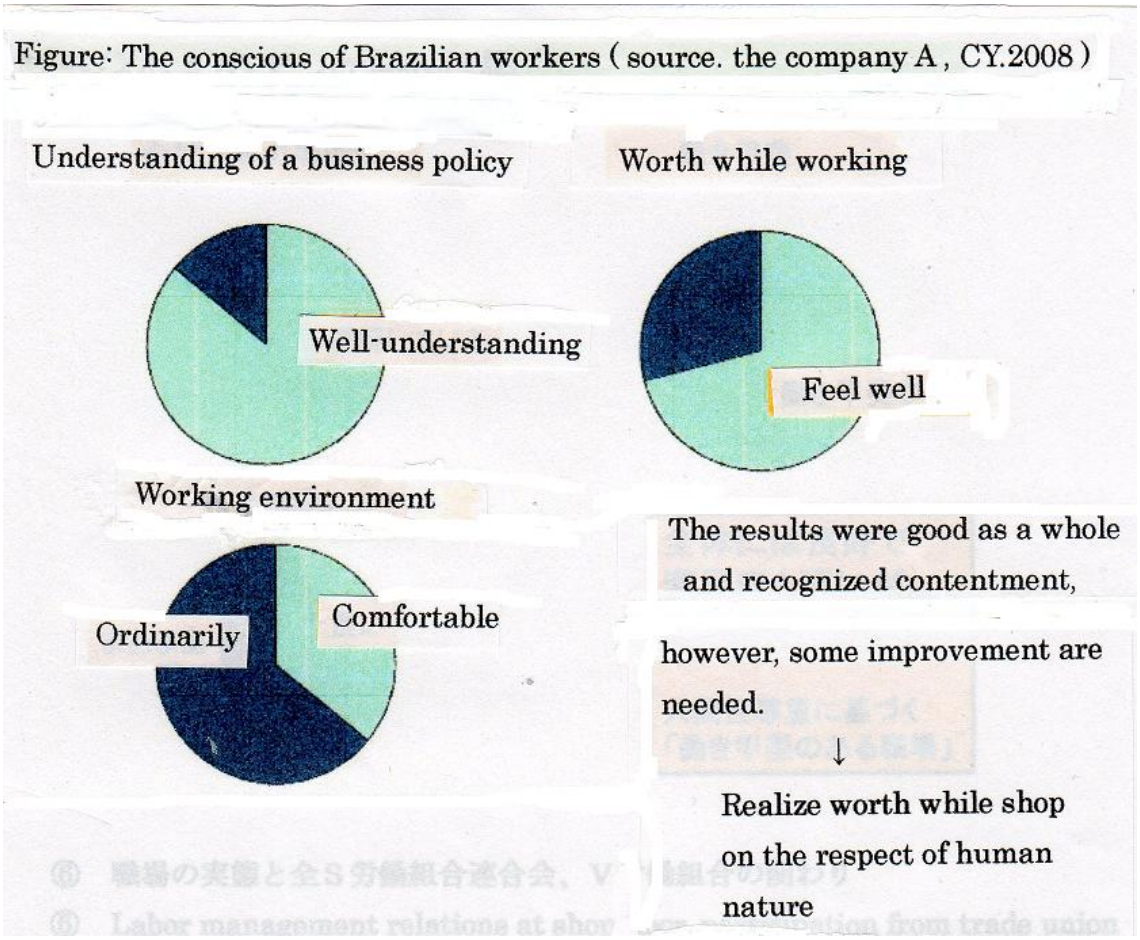
At present, 49 (almost one half) of 105 managerial posts are occupied by Brazilian employees, and a fact worthy of special mention is that the top two of them are the deputy general manager and section manager. And the recruitment of Brazilians is left to the Brazilian managers’ discretion. Particularly the factory operation is seemed to run by Brazilian employees.

And at production sites, an air-conditioning level is almost same as t-1 company in consideration of the climate difference from Brazil and also process display “control panel”, work standard, rate of operation monitor, and “ANDON”[13] (process operation monitor display) are all written in Brazilian language. Also in-house group periodical is written both in Brazilian and Japanese. Also through recreational events 7 times per year, this company intends to produce informal integration like “the traditional Japanese teamwork”.

Such minute personnel policy and accumulation of efforts has produced the company climates over the wall between Brazilian and Japanese workers. Also this seems to dedicate largely to promote a sense of belonging to the company and resolution of difficulties on shop management such as team activities for improvement. The company A calls the guiding principle of this climate as “respect for people”.

The figure below is the answer from the Brazilian employees. This indicates that the personnel policy above is supported firmly by the Brazilian employees.

Figure: The conscious of Brazilian workers (source. the company A , CY.2008)



⑥ Labor management relations at shop floor, participation from trade union

The shop is not organized by any labor union.

On the communication with top management and workers, the top executive say, "in-house family climate is produced and intimate relationship is established through ordinary communication at any place, shop floor or this office. In such open climate, sometimes the executives are invited to employee's informal event. For example, today one of the employee requests me to review some equipment, and now we are considering of replacement. I have forced myself always to be at shop floor." And "I wish to know more and more original suggestions from each employee's," say top executive. This is one of the evidence that he understands and controls each employee, altogether much efforts by managerial posts.

Generally speaking, at a firm with several hundred employees, the top executives are able to know well individual employees ", so the executives may not have a sense to the efficient function of the company-based union that carries on the bottom-up integration, instead or in addition to the function of managerial posts.

Then, for the issues on labor management relations at these small size firms, what kind of stance and activities have taken by the group union organized with affiliates or series group? Especially when the fluctuation of production level and related manpower adjustment are not evadable, how has the group union participated directly or indirectly in a fair and reasonable adjustment of manpower at subsidiary unions or non-union firms?

The company V, t-1 supplier, sites that the company has continuously guided to the suppliers fair personnel management based on labor-management consultation or policy of All Toyota Workers Union.

Of course the personnel management policy should be executed independently by the company A as the pillar of executive right, however such guides or policies above may be accepted willingly. Additionally, as the company A has recruited directory, an establishment of fair work rule and conditions are indispensable to get continuously high quality workforces.

(2) Company B

① The Profile of B[14]

The company B was established in 1947 as a stamping firm. Total employees are 230 as of CY.2007 end. There are 3 manufacturing affiliates in Japan. This company supply products mainly to the V group. This company is placed t-2 on the division ladder of automotive manufacturing because principal customer is t-1 supplier of Toyota.

The sales of FY.2007 was 3.7billion yen, the recurring profits was 46 million yen. The index are 112 sales and 479 recurring profits (FY.2000=100). This has shown very favorable performance. And the rate of sales has depended on the company V up to 74% (including trial products).

The detail of 230 workforces above is consisted with 154 regular employees, 46 dispatched workers, and 30 part-time workers. At each division respectively, 85 direct workers, 30 in-direct workers (who engaged in quality control and shipment etc.), 16 technical staffs, and 23 clerical workers including plant administration. And dispatched or part-time workers are almost all allocated to the production line.

Also another point worthy of special mention on the personnel management is that the company B has recruited younger workers from the north-east district of the People's Republic of China. And they are the Japanese children left behind in China after World War Ⅱ, and almost all of approximately 20 workers are female.

The company B has established annual business policy and has broken down to each section specifically on quality, production, cost performance, occupational safety and

health, and personnel. In this policy, themes or issues to be executed are disclosed, and for assurance, the company executive has appoint the managerial post in charge (usually, general manager or deputy general manager), and has agreed with the person in charge on the schedules, management tools, and evaluation criteria based on the numerical targets.

For example of "Activation of Suggestion system" in the personnel business policy, the president assigns persons in charge and agrees as the commitment with them 56 annual performance targets at the beginning of fiscal year. Then, at daily morning assembly, the president himself check the progress of achievement for the targets, also this results are exhibited on the tally tables. This way, the schemes are followed absolutely. And more, this system, as the business policy execution systems, are not only quality, production, and cost performance such as "cost reduction efforts from TPS or TPM down to cutting waste only just 1 yen, I second, 1 step, 1 drip, or 1 gram", but also "occupational physical risk zero", "realization of good environment at working place", also as the reasonable activities considering of realizing tender environment at working place. As mentioned above, these activities are promoted steadily in the management of business policy system.

And once a month, the president and executives round each shop, there the president follows the "make-clear the problem" and ensure the efforts for resolutions of the pointed-out items. This shows the steady improvement activities as the manufacturing company with practical resolution based on actual shop conditions named "GENCHI-GENBUTU".

The competitive core products are small-size precision stamping parts and wire control cables. Those parts sales account for 52% of total sales. Also, the sales of trial parts sales account for 18%, this means the company's technological excellence. The wire control cables are used for such functions as a rock system of a hood, door, trunk etc., and seat adjustment system.

The principal production processes are consisted with resin molding, die casting, stumping, welding, and assembly. In addition, this company has promoted in-house development of production facilities such as die manufacturing, automated spot welding line, semi-auto resin molding line, etc. , and these efforts have dedicated to the compatibility of multi-type-small-unit production with cost competitiveness and required quality. Further more, 1n 1991 this company established new trial manufacturing facility. This implies higher capability for research and development.

② The device of process for flexible order reception

The object of this study is the main (north) plant of the company B, there processes 3

types of products such as wire cable rod, small size stamping parts, and multi-type-small-unit production of precision parts. And this company is appraised as the manufacturer of the important safety related parts. The stamping machines are all single function type, and there is no automatic transfer type.

Focused on a wire control cables for automobile, as the principal product of this company, after the finished products are shipped according to the pick up KNBAN, the in-process KANBAN[15] and signal KANBAN[16] are issued just same quantity as shown by the number of picked up KANBAN issued by the company V, and only with this in-house KANBAN, in-house production instructions are executed.

Like this, the cables supplied by wire- cable manufacturers are cut off and resin processed at each end according to the instruction of the in-process KANBAN just the same as picked up amounts, and those finished products per parts number are supplied to a stock replenishment. Then, those parts are transferred to a stock replenishment for shipment, after applying spray color for preventing assembly error, installation small size parts, and weighting. Some of them are installed with muffler sponge rubber. There, in-process KANBAN is replaced to the pick-up KANBAN issued by the company V.

The type of production is lot operation system; signal KANBAN are issued according to the pick-up KANBAN, and the signal KANBAN are delivered to the lot formation post.

Then, monthly production is executed according to the production order that is set in the monthly production plan, after the signal KANBAN are reached to the planned number of the sheets that are established according to the pre-determined monthly lot size

Those products are supplied to company V with pick-up KANBAN. The wire cable KANBAN cycle is 1-2-2 KANBAN pattern. And safety stock level is set at 1.5days.
Once this company tried to 1-2-1 KANBAN pattern, but was too difficult to operate, so now corrected to the pattern above and has urged to improve on the actual condition of production.

③ The order reception system

The monthly order reception system is the same as the company A. In the later part of the month the company, The company V informs 3 month scheme, next N month order and N+1, N+2 month unofficial announcements at every part number base. And at the end of the month, next month final order is informed with reviewed N+1, N+2 month unofficial announcement. After this, daily operation is coordinated with pick-up KANBAN issued by the company V.

Again, at the end of the N-1 month, next N month order and N+1,N+2 month unofficial announcements are informed by the company V. Thus, the monthly operating schemes are reviewed repeatedly. Though the accuracy of the unofficial announcement is improved remarkably, however, at the daily base, a fluctuation is comparatively large, the company A said.

At the company B, unofficial announcements are utilized for material procurements. But those are not referenced for production adjustment, as far as such large scale change as requires reinforce of equipment or increase of personnel recruitment. At yet, no such change has happened. The material suppliers require an order antecedent to 2 months, for the variation is so wide and production size is so small that the material variation is inevitably the wider.

If there happened large scale change from the unofficial announcement, at this company such change is handled on daily base without modification of finished stock level through the adjustment of the rate of equipment operation by die change or overtime work.

Also, except resin molding line, in process logistics is based on the unscheduled time and unscheduled quantity conveyance[17], however in future, the company B aims to changeover to the lot base conveyance system.

In spite of Toyota Production System that suggests the scheduled quantity unscheduled time conveyance, the reason why the company dares to adopt such system is largely depends on the variety of products and extremely small size of production per each parts number or detailed specification. Certainly the parts number which are manufactured in a monthly base at this process are up to 63, however the break down of production level are as follows, those production level are less than 100 units per day are 48 in which less than 10 units are 23. Further more, the variation including color specification are up to 320. (Sep. 2008 actual figure)

In some sense, this company's option is reasonable based on an actual condition at shop floor, for efficiency of die or jig change at resin molding equipment, preventing from an inevitable miss assembly in extremely wide variation small size unit production process, and reduction of work load in such process. Yet, of the daily distribution of unit production level are as follows, over 1,000 units are 5, 500 to 1,000 exclusive are 3, 100 to 500 exclusive are 7, other all are 1 to 100 exclusive..

And, stock products for modification are piled before inspection process, so that enlighten line workers to prevent from assembly miss by exposing defective items (that is to say "MIERUKA" ,visualization) which is daring to expose of defective items.

It seems reverse choice according to the principle on the Toyota Production System,

however in another sense, it just like such small or middle size manufacturers to effective production of extremely small quantity on actual shop floor conditions. Also, this is the "wisdom" which flows from experience and devises that are built up in the course of effective correspondence to many issues at wide variation small size manufacturing to be carried by small or middle size suppliers as the substructure of vertical division system.

On the other hand, naturally the business negotiations are opened with material suppliers to adjust order on the fluctuation of 3 month unofficial announcement by the company V. In case of some wire cable parts, the range of fluctuation was around 30%, and for example the parts numbers those range of fluctuation were over 30% amounted to 14 of 110 variations in above 63 parts numbers. (actual figure in Sep. 2008).

Although needed quantity are only 12 kg a month, at the material procurement this company has been forced to accept, in extreme case 150 kg as the minimum lot. Thus, supplying unit of some material are determined by suppliers unrelated to the production level, so materials for small size variations are sometimes obliged to cut off from versatile materials. From this, another issue is come to surface on the supplying principle of material suppliers on the series of manufacturing process.

④ The flexible manpower planning and it's management

The managerial posts are consisted with 3 grades, team leader, foreman, and section manager. Forefront management and supervision is shouldered by the manager. And in general, foreman does not engaged in the line work excluding such tasks as die change that is required high level skill. The management span of manager is rather wide, some covers that of foreman and some are covered by foreman. Generally speaking, this means the flexible management system for the effective shop management over the systematic managerial organization.

The monthly personnel adjustment is executed at each section based on the calculated frequency of die change according to the lot that are built up by the daily production level and storage box size of each parts variation. This daily planning by parts variation is set up on the day of operation calculated from monthly final order planning indicated by the company V.

The manager (sometimes foreman) coordinates and establishes daily manpower allocation to each task and position of work place, based on the skill map that indicates individual skill level with figure "○△×" on the "skill matrix table", and he displays that on the table named "Today's personnel allocation and points of modification". On this manpower allocation, established above, is disclosed on a process chart which indicates each worker's position like bird's-eye view with each worker's photograph

plate. Though the individual skill level is not so much fluctuate, the each workers position is comparatively stable except miner adjustment on the each worker's level of annual paid vacation or rate of machine operation.

Of course, the numbers of KANBAN sheets are fluctuated from daily numbers on the monthly announced planning, however that is no problem because such fluctuations should be deal with at shop floor base, the company said. This means there is a steady leadership of shop manager. In concern, executives as well as in charge of manufacturing have joined the shop meeting in question, and further hear from an individual worker's opinions. In this way, executives have made efforts for improvement of communications.

As a part of activities which aims to strengthen shop floor efficiency and flexibility (so-called "GENBARYOKU"), the top executive himself has working on for worker's motivation up, through the opportunity of reporting the company guiding principles and that of visiting manufacturing sites 2 times a month. And the aim of this executive shop visit is not only to inform his mind to forefront managers by intimate talk but to communicate with each worker, and though these efforts the executive encourage shop floor.

As the N+1 or N+2 unofficial announcements are not applied at production planning, there may be no long term personnel adjustment planning. However, this suggests reliability on flexibility of shop floor. Also this suggests, there may be no such fluctuation that cannot be deal with by shop floor level.

In connection with this, what kind of skill development system is implemented in supporting for such flexibility at shop floor? The main flame of skill training is OJT system. In this course, the performance target is set for each worker in one year base, thus skill formation program is executed at each shop and work site. And the workers who are targeted to this program are not only regular employments but also even part time worker, and that is executed very closely and carefully. The progress of this program is displayed on "the individual training progress map". Perhaps it seems natural that skill training system covers all employees at shop floor, because this company depends on many non-regular employments..

Then, in this very serious recession, how does the company wrestle with the personnel adjustment?

The principal stance is gradual adjustment as follows, reduction of overtime work, sift pattern alternation from day-night shift to continuous 2-shift. And if such means are not effective, personnel reduction is inevitable from contract relies of temporary staff at the end of contracted term. This choice may be right in the sense of return on

personnel investment or in house skill reservation.

⑤ **Labor management at shop floor base and the influence of the union**

The union organization may not be realized now and future, the company said. Surely, at this size of operation the executives can easily distinct each worker, so it must not be necessary to monitor shop floor through the union organization.

On the other hand, the executives expected the guidance by the company V on union activities or labor relations in the group level. From this, the indirect effects are identified from the labor relations at company V or the policy of All Toyota Workers Union.

(3) Company C

① **The Profile of C[18]**

The company C was established in 1954. The skilled workers are 100 in the total employees 167. (CY.2007 end) The personnel feature is comparatively high percentages of regular employees, the number of regular employees are 84 in all workers at manufacturing sector.

This company supply products mainly to the V group, The depending rate on the company V is up to 97%, so this company is placed t-2 on the division ladder of automotive manufacturing because principal customer is t-1 supplier of Toyota.

The sales index of FY.2007 was 167 (FY.2002 = 100), and increasing its results. Also, recurring profits are constantly increasing, and in FY.2007 remarked +4% per sales.

The main products are precision press parts for electronic appliance etc. The typical products are rotor water pomp, ABS sleeve solenoid, crevice for master-cylinder, retainer spring, retainer solenoid for automatic transmission, rock poll, and plug etc.

This company has epoch-making technique, for example, the casting and machinery process were changed to precision press process, and this realized surprising cost reduction, and especially stainless process technique for deep drawing and blanking press are evaluated as supreme level and trusted.

In the main process, precision process machine, such as progressive press machine, transfer press line, single small press, NC electric discharge machining, machining center, are placed, in addition and notable as that various kinds of precision recorder are innovated.

② **The device of process for flexible order reception**

The object of this study is the process where consisted with the automatic progressive press machine and 13 single small presses. The manufacturing process are finalized, after stamping each parts are processed at barrel finishing, welding, plating, black

color oxidation according to detail specifications indicated by each parts number. Still, except stamping and a part of barrel finishing, all other process are out sourcing.

The finished products are supplied according to a pick up KNBAN, The KANBAN cycle is 1-2-3 for main custom. However, for some customer, 1-1-1 cycle is realized by such efforts as reduction of preparing loss for shipment.

In CY.2001, this company has changed the die manufacturing from out sourcing to in house process, also this company has introduced TPM[19] and established TPM promotion section under the direct control of the president for skill development and skill succession. In this way, manufacturing process and systems are remarkably improving, and in CY.2002, supported by the company V, this company was praised TPM challenge from Japan Plant Engineering Association. This is the evidence of the company's technical excellence in die manufacturing and plant maintenance.

③ The order reception system

The 6 month unofficial announcement is informed from the company V, as the long-term announcement.

At the same time, in the later part of the month the company V informs 3 month scheme, next N month order and N+1, N+2 month unofficial announcements at each parts number base. And at the end of the month, next month final order is informed at each ten days of the month together with reviewed N+1, N+2 month unofficial announcement.

After this, daily operation is coordinated according to the pick-up KANBAN issued by the company V. Again, at the end of the N-1 month, next N month order and the next N+1, N+2 month unofficial announcements are informed by the company V.

Thus, the monthly operating schemes are reviewed repeatedly. As sited before, the accuracy of the unofficial announcement is remarkably improved to the level within the 10% or less fluctuation. Needless to say, it makes easier to manage the operation.

This is the same condition as the case of the company A.

On the 6 months unofficial announcement, at first, the performance of 4 principal facilities, which constraint the performance of whole line, are confirmed at 1 or 2 shift base. After this, for example, an efficient equipment investment for capacity-up or machine load reduction by rearrangement of machines are examined according to the actual order from the angle of equipment investment saving.

Also at the company C, N+1 month production and procurement plan are established on N+1 unofficial announcement informed by the company V at the later part of the month. Based on this plan, in-house manpower arrangement and material out sourcing order are executed. After 1 month later when the plans are determined,

additional or cancel of a part of production and procurement are executed. Same as the company B (mentioned above), because of required high quality and precision level for materials while wide variation small size unit production process, the company is obliged to concede the manufacturing conditions advantageous for material suppliers. This may be the back ground of the 2 month prior production plan and pre-procurement order by the company C.

After informed next month production schedule from the company V at the latter 10 days of each month, at each parts number, production order and daily production schedule in next and the next(N+2) month are established based on the optimum condition of reasonable stock level and lot size. As mentioned above, this monthly scheme is reviewed at every preceding 1 month, and through this process, fluctuation of production are relieved just as the same way as moving-average.

At the daily production control, the daily adjustment of operation is adjusted according to the differentials between the scheduled level set in advance and the daily order level by the pick-up KANBAN or e-KANBAN displayed on the office computer.

Accordingly, the materials of the products are picked up with inter-process KANBAN considering the standard lead time (the necessary stock level expressed by number of days to meet the daily pick up by the company V) from the stamping store preceding the products that have fall below the criterion level of the finished and in-process product level. And after in-house processing or out-sourced, those finished products are packed in fixed quantity and refilled into the shipping store. This stamping line is operated on the lot production system, and is refilling each parts number with the same quantity as picked up by signal KANBAN.

The distinction of the standardized inventory control system at the company C is an indication system of inventory level with a number of waiting days for shipment. This means that the company intended to make clear the reasonable inventory level (so called “MIERUKA”, visualization) with replacement by a level of days for shipment, because, in general, “reasonable inventory level” is lost sight of at stamping process. At the same time, this endeavor is significant step to a reduction of lot size as so to speak the never lasting theme at stamping process through encouraging worker’s consciousness of the level of inventory.

The issues remained are, as the company cited, the reduction of standardized inventory level for shipment. The company say, the total number of ordered parts numbers are 2,822 (as of June, 2008) which are consisted with as follows: each production size of 2,000 parts numbers are under 100 pieces per month (less than 10 per day) that correspond to 70.9%, also more than 100 less than 10,000 pieces per

month (more than 10 less than 500 per day) correspond to 18.8%, and more than 10,000 pieces (more than 500 per day) correspond to 10.3%.

However, on the sales base, a parts numbers of more than 10,000 pieces accounts for 87.8%, and the parts numbers less than 10,000 pieces per month occupy only 11% of the total sales.

Nevertheless, the stock structure of finished products are occupied at 66.5% by less than 10,000 pieces parts numbers, especially 39.6% are occupied by less than 1,000 pieces, and 22.6% are occupied by the less than 100 pieces per month. This means that up to 60% of total stock shelf space (store for finished products) are occupied by the parts numbers less than 1,000 pieces per month.

Perhaps such parts numbers as extremely small size production cannot be dedicated to the company performance. The decrease of inventory by a reduction of lot size or an improvement of lot formation is inevitable issue, and also that is common issue not only for the company C also for A and B. The policy "Improvement of process performance of small size parts production by reasonable lot formation synchronized to the pick up pace and the more efficient die change system" should be put the first priority for the executives of the company C, and the composition of sales amounts by production scale of each parts number above has shown this undoubtedly.

Also, one more burdensome issue for the reduction of inventory is considerable dependence on out sourcing. For example, the lead time of 800 parts numbers which are almost daily produced is fluctuates seriously. The fluctuation level is as follows; 31% of 800 parts numbers are 1-3 days, 30% are 8-5 days, and 15% are 2-1 days.

Considering the KANBAN cycle of the company C mentioned above, this is one of the reasons why the company accumulates higher inventory level. Thus the reduction of the outsourcing rate must be the long term executive issue including the review of make-or-buy balance. The company C has now made great effort to "improve shop performance through the review of small piece production process and stock system".

④ The flexible manpower planning and it's management

On the monthly manpower planning, after necessary time of the stamping machine operating are computed based on the monthly order amount (this procedure is called "ZOMEI") and at the same time based on the stroke per minute of each machine, manpower planning is established at each group of equipment in consideration of proper allocation of workers who possess enough skills to operate machines properly including related works such as quality confirmation. This system is called "TEIIN SEI"[20] (fixed manpower capacity line), and the company is eager to reduce TEIIN through improvement of the line. Thus working load reduction is realized through the

reasonable manpower planning on an actual machine operating availability, and, from the stand point of management, this encourages an initiatives of fore front managerial posts and urges them to lead improvement at each group through equipment and process review.

An allocation of each worker is executed based on the machine operating skill. The process in charge of each worker is shown on a panel that indicates bird-eye view of whole process of the group, and side by side the table (so-called GINOHYO) that indicates the evaluation of skill level at each worker is stick up. As mentioned above, because of manpower shortage, the increase of the order amount must be filled with overtime work or review of shift pattern. There is nothing to worry about at present stable production level, however from a long viewpoints, the company may be confronted complicated issue between fixed cost reduction and opportunity loss of sales or excessive labor load. At the same time, if recession comes, wishful investment must bring about the more heavy pressure of fixed cost. And now in the severe recession the company has confronted serious personnel issues.

At the daily manpower allocation, the managerial posts in charge considers properly of such factors at each shop floor as the each worker's level of annual paid vacation and work load (level of over time worked), rate of attendance, number of line-working managers, scheduled retirees, long term absentees, restricted task workers, percentage of non-regular workers, and productivity improvement etc.

The position in charge is, same as other 2 companies, the forefront assistant manager.

The managerial post structure of the company C is consisted with 3 levels, team leader-assistant manager-section manager. Also the assistant manager is in charge of forefront shop management on the manpower, quality, and delivery.

How about the skill development program are? The policy of the company C is "All workers should be trained and grow up to the skill level of set-up stamping die". In this connection, after join this company all workers at first exercise at die manufacturing process, and in this exercise, each worker's talent is evaluated and, based on this, each worker is assigned to mass production process such as machine maintenance or stamping process etc.

Especially, at die manufacturing process, high level skill is required, so the company have to depend on regular employees' efforts for long term skill development.

Of course, the skill level which is required at precision stamping process is not unskilled level. This means that the company C has urged company wide skill development, and also has laid great stress on regular employees as the core of skill.

The personnel composition of skilled 100 workers are, regular employees 84,

temporary and part-time employees 7, dispatched workers 6, others 3. Compared with the same size company, the reason why the rate of regular employees is considerably high is comprehensive from the angle of major stress on skill development. The company C say, for regular employees the company set a in-house career course, those are; machine operator → set up stamping die → assistant manager. As the result, the thick stratum of high skilled workers who are capable of die set up at all machines has been established. Also, a subjective self training at group level is encouraged by the company, and 2 times a year the activities are checked and appraised by the president.

Other problem may be come to the surface in the decline of sales, for the flexibility of manpower adjustment is considerably restricted in such high rate of regular employees. In such situation, the most important issue is how to motivate each shop. The group level shop training above is as a part of such activity. The company C has urged to expand such activity from "dot to surface" (so called YOKOTENKAI [21] as company-wide improvement activities).

Any way, the indispensable base of flexibility of adjustment and motivation is the personnel identification at shop floor. For encourage the identification at shop floor, various kind of recreational events are taken place, altogether with such daily labor management or improvement activities by the managerial posts.

⑤ On the possibility of the union organization

At present, any type of union is organized at the company C.

The company C cited, if such person as are appropriate as the representative of employees were brought up, then the possibility might be higher. Considering of the personnel size, the company's decision may be reasonable, for the executives can easily recognize each worker, in addition the suitable leader is not yet grown up.

Section 3. The verification of at tear 2 in KEIRETU

(1) The flexibility for production fluctuation ad it's accompanied issues

The common character at each company is that they share ultra many variation in micro size production, and for corresponding to such request, they make efforts to develop their original production system which are applied the Toyota Production System with some modification according to their process peculiarity or shop actuality. This is common tendency observed even at either lot production style stamping maker or resin molding maker. And for example, with this process improvement the company C has been success to absorb the fluctuation of monthly production plan informed by

t-1 supplier and also that of pick up KANBAN.

At the stumping suppliers to the company V, they all introduced actively the Toyota Production System (TPS), Total Productive Maintenance (TPM), and make efforts to reduce safety inventory level on the assumption of corresponding surely to pick up by t-1 suppliers especially by the company V, therefore an activities for improvement are continued to realize a optimum coordination of production order and lot formation.

As a part of these efforts, for preventing from assembly error and secure required quality, the company B dare to changeover in process logistics to the lot base conveyance system from the unscheduled time and quantity conveyance system which has been adopted now. The company sites this changeover may be the most suitable way to prevent from assembly errors not only in such over 300 variation ultra micro production but skill differentials from labor construction between t-1 and t-2 supplier.

This policy should be understood as one of the actual implementation of the Toyota Production System to t-2 small size manufacturers.

However, the effectiveness of t-2 suppliers' serious efforts may have some limitation.

That is, whether such effort can be successful or not depends on the procurement policy of t-1 suppliers.

Then, procurement policy of t-1 suppliers should be reviewed next.

The first issue is the improvement in accuracy of production scheme and unofficial announcement instructed by t-1 suppliers. For each supplier to the company V, the stability and accuracy of fixed schedule and unofficial announcement instructed by the company V is the prerequisite condition to be able to process small size ultra many variation by flexible lot formation. On this issue, the company V has informed closely by each parts number at each timing when the company informs monthly order and after the next month unofficial announcements, which are repeatedly reviewed to be more accurate. In addition to such activities, the company V introduced e-KANBAN system into some pick-up process with t-2 suppliers to alleviate the fluctuation of KANBAN. As the results, the fluctuation range of the schedule is now within 10% approximately.

Since each supplier has establishes the production order and the lot formation schedule on the monthly base, such activities by t-1 suppliers as mentioned above, (improvement in accuracy of unofficial announcement system, introduction of e-KANBAN system for reduction of daily fluctuation etc), may much dedicate to an improvement of work load at suppliers' shop floor and also bring about the reduction of safety inventory level.

In this meaning, those activities are significant as one of the indispensable roles of t-1

suppliers for mutual reliability between t-1 and t-2 suppliers.

The production size of each parts number shows that a considerable amount per single parts number is ordered along with many ultra micro size orders. This may be the concern for supplier's finance by the company V, because if all parts numbers were ordered in ultra small size unit, t-2 suppliers would be reconciled to be less profitable operation and finally to go financially difficult position.

The issue that remains is the reduction of procurement lot size of materials. Of course, the impetuous change of procurement system by t-1 supplier is not always best selection. Because that spoils the efforts for improving procurement know-how fit to such small size material arrangement also that may deprive of value-added opportunity from such small size suppliers. The most reasonable way should be developed that realizes not only profitable for both buyer and supplier but also maximum performance in "quality, delivery, cost" from stand point of successive value chain from t-2 suppliers to assemblers.

Then, what kind of process the production adjustment succeeded with to the manpower arrangement? Whether is there any room where has caused an unreasonable work load or not?

(2) The manpower management on the flexible production adjustment

The manpower adjustment is executed monthly base on the production schedule and unofficial announcement from the company V.

From survey results, for realizing the effective rate of machine operation and reasonable work load, at first the manager has to check the work load or unevenness of it for required production of each parts number based on the equipment capability of each line (actual operation base) and rate of machine operation. At the same time, the manager has checked worker's allocation and execute line-wide adjustment of manpower including supporting member to correct the balance of work load among related lines and reduce the total hour of worked to reasonable level. Those activities may aim to realize the compatible with performance of machine operation and the reduction of work load through reasonable manpower allocation at each line and process.

Specifically, at first based on the required amount indicated in the next month fixed order, production level at each line is calculated at each shift base, and next, for minimizing both standard inventory level for shipping and set-up frequency, the optimum production order and set-up frequency are scheduled on the lot size (the most efficient composition based on the accommodation size of each pallet "named HAKO").

This called “lot formation”. Then, the required total working time are computed which are consisted from direct time worked (net time = cycle time & set-up time + repair time + machine maintenance time), in-direct time worked, and others. And based on this total working time, required manpower and personnel arrangement at each production line are determined. From this manpower arrangement process, it’s identified clearly that a non-excessive and reasonable manpower planning is prepared considering equipment availability too.

The manpower allocation is disclosed on a process chart which indicates each worker’s position like bird’s-eye view with each worker’s photograph and/or name plate. .As the result, each worker is able to aware who is in charge of which process visually.

The daily manpower allocation is determined on each worker‘s skill level that is displayed on the skill level table (on which skill level is disclosed with 4 rank divided circle / square figure or bar graph, and those levels are reviewed monthly) side by side with the manpower allocation table at each process. And the managerial posts in charge considers properly of such factors at each shop floor as the each worker’s level of annual paid vacation and work load (level of over time worked), rate of attendance, number of line-working managers, scheduled retirees, long term absentees, restricted task workers, percentage of non-regular workers, and productivity improvement. This indicates that how closely the shop management and personnel allocation are established by the forefront managerial posts.

The application of unofficial announcement is different from each company.

For example the company A, which employees 352 (515 employees at domestic 5 group companies), and has 2 production & 2 service subsidiaries in Japan, also overseas subsidiaries in US and China RP., has established the policy that the company intend to slough off the subcontractor by it’s effort to realize overwhelming level of quality and technology as mentioned above. On this policy, for example at the objective line of this survey, the original equipments and manpower planning are established that intends to realize proper rate of machine operation and reasonable manpower planning based on the schedule not only 3 month base but also 6 month or 1 year base in reference on the t-1 supplier’s long term scheme.

The company B, middle class company with 3 factory and employees 230 in Japan, the unofficial announcements are applied only to the procurement of materials, and those are not applied to production adjustment only such case as the frequency range is so large that the company is obliged to review equipment capacity or manpower level. Production and manpower planning are established based on the monthly fixed order,

and the frequency of the pick up KANBAN is managed with HEIJUNKA system. There are 63 variations of parts number in actual base, however including detail specification that are not numbered as a parts, the actual variations are over 300 even at this time surveyed line. In addition, the frequency range of unofficial announcement is approximately 30% at parts number base. Such frequency of unofficial announcement concerning with ultra wide variation and small size cannot make it possible to apply unofficial announcement but only to the material procurement. As mentioned above, the improvement in accuracy of unofficial announcement at detail specification base by t-1 suppliers is the urgent issue for the company B.

While, an indispensable factors for managing such ultra wide variation and small size production are firstly developing the basic skill level, increasing numbers of the multi skill workers, and establishment of tough workplace with higher motivation of all workers, (so called "GENBARYOKU")..

The labor construction is different by each company, and as the company A expects skill base on the direct recruited Brazilian workers while the company C on the regular employees. From this, the personnel group on which each company expects the core of the skill development and labor management is different, however on the way of skill development, the OJT skill development system at every shop is common at each company.

Next, labor management relation in a broad sense should be reviewed, which are the labor management at manpower adjustment or communication system for reinforcing the identification of shop floor and motivation of each worker.

(3) Labor management relation in a broad sense

Any type of labor union is not organized at each company, so taking up the relation between management and labor, the actual labor management for encourage the GENBARYOKU mentioned above should be illustrated.

The company A has adopted interesting attempts, concerning with the policy for identification of production site, motivation of the workers, and so called GENBARYOKU above.

Same as other Japanese workers, the company A has direct recruited Brazilian workers consistently from the beginning, and it fostered in their mind carefully with "consciousness of own company". As the result, identification over nationality may be sprouted, the company analyses. .At present, near by one half of all the managerial posts at the company A are Brazilians. (49 Brazilians of 105 managerial posts, the top class position of Brazilian is assistant general manager and section manager) In

addition, the recruitment of Brazilian workers is entrusted to Brazilian managers, also even “the operation of factory is managed” by the Brazilian managerial posts, the president say. Also recreational events are set 7 times a year to integrate Brazilian and Japanese. The president is eager to establish “Japanese traditional warm team work” as a part of corporate culture..

The continuous efforts in labor management, in which personnel management and promotion regardless of nationality or labor management including informal integration are executed, urges an establishment of corporate culture that has no such barriers between “Brazilian” and “Japanese”, besides that may dedicate the dissolution of pressure at shop management, for example raising identification to the company or activity for an improvement at shop floor. The company A sits that the foundation of this culture is “the climate to treasure employees”. The survey above shows that the effort by the company A has reaped a rich harvest.

Also on the communication between top executive and employees, the president said “the sense of family atmosphere is produced at the company A. There are already enough interactive communication routs, for example I hear opinions of employees at shop floor or, in reverse, they come here to inform their opinions. And I hope the more employees’ opinions inform to us executives.” Altogether the efforts by the managerial posts above, this remark by the president proves that the president himself comprehends the real intension or the true color of shop floor.

On the relationship between top executive and the shop floor, the company B has made effort deliberately to communicate with the shop floor, for example, at the meeting executives in charge of production and related departments talk with employees on the selected shop issue or hearing individual opinions. As a part of strengthen “GENBARYOKU”, the top executive himself has worked on improvement of motivation at such opportunities as hearing reports on the progress of the improvement scheme,. And through the visitation of production site 2 times a day,, he aims not only to strengthen GENBRYOKU above also to inform the top executive’s policy or intention to the fore front managerial posts directory.

In case of the company C, the objective themes are set by group as managerial units, and the progress are reported to and checked by the president 2 times per year, thus subjective study are required at each group. .Altogether for encouraging identification of employees, friendship tour and other recreational events are held together with the labor management by the managerial posts.

Like this, it may improve identification to the company and encourage employees’ motivation which in turn improve GENBRYOKU, through the president himself takes

the initiative in improving mutual understanding with shop and each employee in cooperation with the managerial posts.

Generally speaking, if the executives do not fail to make efforts mentioned above, executives can easily recognizable and discernible all employees at several hundred size company. This means that the employees might depend neither representative function by the trade union, nor executives expect any monitoring function by the trade union. Incidentally, any type of labor union is not organized at 3 companies surveyed at this time.

In such circumstances, for realizing reasonable manpower adjustment accompany to production fluctuation, how does the federation organized on the company based labor union concern directly or indirectly with the manpower adjustment at non-organized affiliated (KEIRETU) companies?

According to the company V (t-1), beforehand based on the talk with the federation of V group company-based unions or on the federation's guiding policies, the company has guided affiliated companies not to execute unreasonable labor management.

Also, the All Toyota Workers Union (ATWU), which has organized Toyota KEIRETU, positively urged saving the opportunity of employment and checked reasonable labor management from the stand point of whole KEIRETU. In that connection at this recession since 2008, the ATWU immediately announced a principle "the ATWU encourages affiliated unions to sweep-away of employment anxiety and to secure stable employment". And especially for subcontractors, the ATWU has not only asked affiliated unions close care of contract observation, but also even after expertise urged them to desire each company for necessary fringe benefits. In addition, the ATWU instructed affiliated unions to follow the results as one of the talking points on the spring wage round.[22]

Of course as one of the principal function as the executive privilege, personnel or labor management is executed by each company in their own way, however through such labor management as above, non-union affiliates may be obliged to be influenced from the federation of V group worker's union. In this connection, the company B intended to be guided by the company V about the union activities or group-wide issues on labor relations.

From this actual condition, the federation of union is expected to carry out leadership not only affiliated unions but also non-union shop floor at t-2 companies.

(4) conclusion – The verifications and issues in KEIRETU system－

Generally speaking, the quality level were not improved to such extend as shipping

no-defect products, it would be impossible to introduce the synchronizing production with upper tier suppliers or pick up by KANBAN system. Without such condition were not produced, upper tier suppliers were suffered from not only excessive burden but also much loss caused by production stop or machine troubles.

So, at first former tier suppliers should improve it's quality level to such extend as reception without inspection, and in this process of improving quality level, the inventory in process has to be reduced and frequent delivery has to be drive for with "step by step" method. At least 3 companies this time surveyed, there is no problem in quality, and all companies have adopted shipping system according to the pick up KANBAN or the orderly pick up system.

As far as theoretical view, the efficient orderly pick up system is developed through realizing a reasonable combination of the smaller lot size and reasonable production order, then the synchronizing orderly production could be developed between suppliers. As the results, their must be no room for accumulating unreasonable finished inventory at suppliers.

In an actual condition, each company has engaged to improve productivity or reduction of fixed cost based on the fundamental principle or origin of Toyota Production System. As the results, through these efforts the reduction of the "muda" in inventory are steadily removed and this dedicates financial position of suppliers.

Simultaneously, each supplier have much efforts for realizing frequent delivery, and for development of non-expensive but reliable orderly pick up system through reduction of lot size and set up time on presuppose of lunatic small size production with extra much variation. On the safety inventories at the shipping store, which is set by each company based on the monthly order or unofficial announcement from t-1 suppliers, should be considered as the tentative level of necessary inventory in the course of such improvement.

The advancement of these activities is the new type of orderly pick up and delivery system of the distribution warehouse. This system aims not only to reduce the safety level of inventory at each supplier by integrating efficiently the direct shipping process at each supplier but to correspond effectively to mixed production processes at t-1 suppliers. If the inventory level could be reduced at the distribution warehouse through logistic improvement and parts sorting or orderly pick up are covered on behalf of the parts reception at t-1 suppliers, it may be possible not only relief of work load at t-1 supplier's parts reception also the productivity may improve and the reduction of distribution inventory at all series of process from shipping at t-2 suppliers to reception and orderly pick up at final assembly maker.

At the same time, this new logistic condition may urge the evolution caused with e-KANBAN system.

The conclusion on above facts observed at each company surveyed, such prejudice as “an unreasonable instruction to suppliers on inventories” is not applicable at Toyota KEIRETU. In this connection, there are no such subjective or victimize consciousness in the survey results.

From the stand point of executives, the work load reduction through improvement on accuracy of order information or reduction on frequency of pick up KANBAN, and the procurement policy for ordering considerable amount of specific parts number together with extra small size production of many parts variation, these facts indicates t-1 supplier’s procurement policy to realize symbiosis with t-2 suppliers.

And on the personnel adjustment, manpower allocation is balanced, and work load is adjusted within a reasonable time worked considering mutual support members and an individual allocation. This aims to realize the reduction of work load through improvement of machines operating rate and reasonable assignment of each employee,

Also on the process assignment of each worker, at any company forefront managerial posts realize the optimum allocation on the individual skill level table also considering each worker’s conditions. This means that the system aims to realize non-excessive personnel distribution based on the actual shop floor condition. Taking about the total manpower adjustment system mentioned above, in reverse of some misunderstanding, this system never presses excessive work load on workers unilaterally by the management.

Besides, through the intensive communications between top management and employees, opinions at the tail end of shop floor are surely integrated and reflected in corporate management. And the influences from the federation of Toyota group union or that of t-1 group union are identified directly or indirectly. So the federation has to consider such influences on t-2 non-union organized companies.

Finally, the remarkable fact is that, in spite of the requirement for very severe correspondence to quality standard, cost level, and accuracy on delivery, sales at each company is increasing steadily in long–rang. And in recent recession, almost all suppliers which have not neglected self-help endeavor but have made great efforts to develop competitiveness of their products are evading catastrophe in corporate financial position.

This is the result of consistent procurement policy executed by Toyota and especially t-1 supplier. Wada(1991) indicates that since 1970s Toyota determined to refer to t-1 suppliers the responsibility of counseling quality control at t-2 suppliers. And

according to the analysis by Asanuma(1984), this is the reason why the system that a reasonable share of cost reduction suggested by supplier is return to the supplier is well established. That is to say, through Toyota has nourished t-1 suppliers, core of synchronized network with Toyota Production System, to be a mini-size Toyota, the company has been monitoring suppliers at each tier and encourage mutual competition. And the company, in this course, established the “close relationship (wada1991)” based on the principle of “fare evaluation for improvement, and reasonable rewards”. From the viewpoint of business history or procurement policy, it’s demonstrated that there are no such facts as “an unreasonable instructions to suppliers on inventories and parts price”.

Rather, couple with these procurement price determination rules and the procurement policy by t-1 suppliers, solid growth of the Toyota KEIRETU including t-2 suppliers may have achieved.

From the review into the actual condition, the issue for future is to encourage the continuous evolution and refine of the existent system through subjective efforts by the companies at each tier of KEIRETU.

— end —

Notes;

[1] muri, muda, mura mean overburden, waste, and unevenness. These are known collectively as the 3 M's.

[2] e-KANBAN system is refined type of traditional KANBAN system supported by the information technology.

[3] HEIJUNKA is the overall averaging in the production schedule of the variety and volume of items produced in given time periods. The averaging is tied to sales.

[4] KANBAN are small signboards easily held in one hand, with necessary information about parts. Supplier KANBAN is attached to parts containers coming from suppliers. These KANBAN are basically used the same way as inter-process, pick up KANBAN.

[5] Takuto Time is the time it takes to produce a component, or enough identical components, for one vehicle. It is figured through daily total operating time divided by required total production for the day.

[6] Set-up time is the time it takes to change over, from the instant that the processing of the last component of one type is finished, to the production of the first good sample of the next type of component. It includes all the time needed for changeover of the dies, cutting tools, etc.

[7] Scheduled quantity (unscheduled time) conveyance is a system used for jobsites to pick up parts from earlier processes whenever they have used up most of their current supply. The deciding factor is how many parts have been used and how many remain, not how much time has passed since the last pick-up.

[8] The fact-finding on the spot, Sep.19,2008.

[9] GENCHI GENBUTU is the fundamental method for improvement, check the actual article and confirm actual facts at the actual site. The aims are to exclude a prejudice, arbitrary decision, and misunderstanding.

[10] KANBAN cycle is the daily delivery cycle for a particular part. It is a set of three numbers which tells how many deliveries will be made in one day, and how many latter the next delivery will be made. The KANBAN cycle is written on a supplier KANBAN.

[11] Multi-process handling means doing the required number of operations according to the working order, and on-schedule with tact-time.

[12] Cycle time is the standard time that is the worker who is assigned to the process does one cycle of all tasks provided in the standardized work smoothly and naturally.

[13] ANDON is a electrical board which lights up to show at a glance the current state of work operations. ANDON boards allow speedy corrective action to be taken by a supervisor when a problem arises.

[14] The fact-finding on the spot, Sep.24,2008.

[15] In-process KANBAN indicates how many and what kind of parts have been passed from one place on the production line to the next place. It is a signal to begin processing exactly the sane type and number of items that were passed along.

[16] Signal KANBAN is used when different items are being processed on one line, and time is needed for changing dies.

[17] Under this system, conveyance moves whenever the earlier processes have manufactured scheduled quantity.

[18] The fact-finding on the spot, Sep.29,2008

[19] Total Productive Maintenance is carried by the self-disciplined small-group at each shop, and the aim is to realize at most efficiency of equipments for their life-time through maintenance prevention (MP), preventive maintenance (PM), and corrective maintenance (CM), etc.

[20] Fixed manpower capacity line requires a constant, fixed, number of workers. The number of workers will not change whether the amount produced varies or not.

[21]Through YOKOTENKAI a efficient improvement become common with in-house similar shop or process

[22] The fact-finding on the spot, Feb.2009

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