PRODUCTIVITY ENHANCEMENT AT INDUS THROUGH FOCUSING ON 3M'S

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Productivity Enhancement

The Need

A Pakistani company practicing Japanese management, had plant capacity of producing 10,000 vehicles/ year in single shift. With the signing of Technical Assistance Agreement with Daihatsu Motor Co. Japan, for production of 850CC Daihatsu Cuore 3,000 Units in the first year, increase in production capacity by 30% became inevitable. One obvious conventional method was to increase the number of work stations which would have resulted in capital investment for providing additional equipment / tools & utilities on one hand and consequent increase of manpower on the other hand. However, it was decided to increase the capacity by improving productivity.

In simple terms, the requirement was to increase daily production from 38 vehicle/ days to 50 vehicles/ day thus reducing Takt time from 10.5 minutes/ vehicle to 8.5 minutes / vehicle.

The Strategy- Reducing Man Hours Through Reduction In 3Ms.

Understanding of 3Ms

3Ms is an abbreviation of 3 Japanese letters which start with English Alphabet 'M' namely:

MURI = Over Burden
MUDA = Waste
MURA = Unevenness

The concept can be best understood from the following diagram:

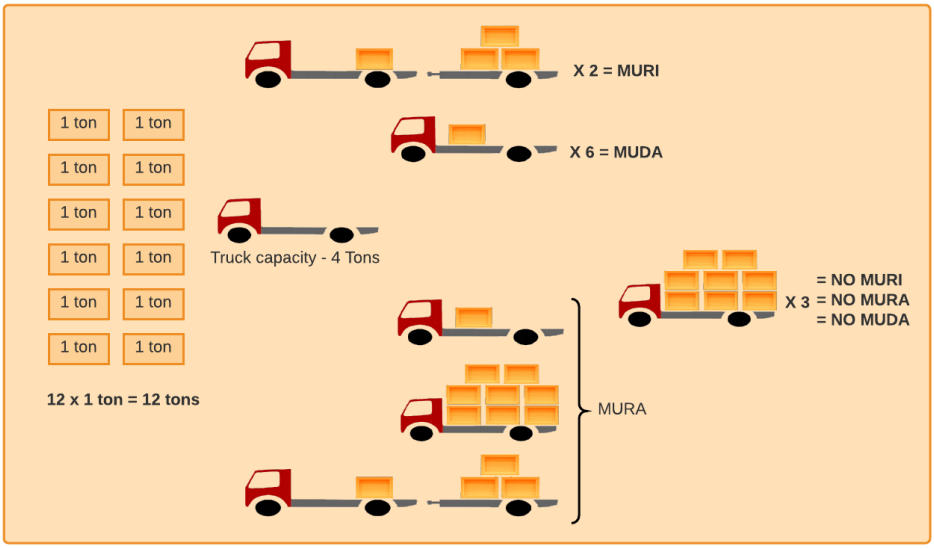


Figure 1: MUDI, MURA and MUDA

Here 12 boxes of 1 ton each need to be transported from one station to other with the help of a pickup of 4 ton capacity. If the operator chooses to load 6 boxes at a time and makes only 2 trips, he is overburdening the pickup and also himself. The short-term gain of making only two trips, will be nullified by excessive maintenance of the pick up resulting from over burdening, this is "MURI". The operator has another choice to make 6 trips by carrying only 2 boxes at a time. This is sheer"waste" which is "MUDA" as the cost of transportation will escalate. He may also choose to make 3 trips, but the loading in each trip may vary, e.g. 1st trip only 2 boxes, 2nd trip 6 boxes and 3rd trip 4 boxes. This is unevenness of operation and is called "MURA".

If one takes a close look at the operations, identification of MURA & MURI in production processes is somehow easier. However, the identification of 'MUDA" is somewhat overlooked. MUDA can be in anyone of the following forms:

1	**MUDA of Motion**	Any motion that does not contribute directly to adding value.
2	**MUDA of Correction**	Any Repair is MUDA.
3	**MUDA of inventory**	Any more than the minimum to get the job done.
4	**MUDA of conveyance**	Any conveyance is essentially MUDA. Should be kept to a minimum
5	**MUDA of waiting**	Waiting for parts to arrive or for a machine to finish a cycle.
6	**MUDA in processing**	Over processing
7	**MUDA of over Production**	Production too much or too soon

Commitment & Challenging the existing

The prevailing Manhour/ Vehicle for each process were as follows:

Department	Production Department				Production Planning & Material Control	Quality Assurance Department
Process	Welding Process	Painting Process	Assembly Process	Engine Assembly	Part Supplying	FInal Insp.& Audit
Man hours/ Vehicle	10.0	12.0	7.0	2.1	8.3	5.0

Figure 2: commitment & challenging the existing

Each department / Section of a Pakistani company practicing Japanese management, was asked to examine critically each work activity at every station and eliminate / reduce 3Ms specially the MUDA. As MUDA will reduce, the time spent for doing a process will reduce, which will in turn reduce Man-hour/ Vehicle.

The basic philosophy adopted was to challenge every current activity on the workstation and pose fundamental questions like, why the activity is necessary? Can it be eliminated altogether? If not, can the time be reduced for doing the

same activity? Is this the best method of doing it? Can we merge this activity with some other activity for better result? Can this activity be brought forward? Or can it be done at a later station? etc..

All shop in-charges and supervisors of each and every section were clear and committed for their goals and made their activity plans for achieving the same.

Yamazumi chart - The Tool

Yamazumi is a Japanese word comprising Yama (Mountain) & Zumi (Building up) meaning 'Building up of Mountain". It is a measurement of total time taken in Minutes/ Seconds for completing all activities resulting in a finished product. The time spent for doing any process can be divided into two broad categories:

a) Time spent in doing Standard Job Element
b) Time spent in MUDA (walking, picking, unpacking etc)

A standard job element is a value added activity e.g. tightening of bolt for fixing a part, which may take 6 seconds. However the time spent in walking to a rack &

picking the bolt and bringing to work station which may be taking 4 seconds is a non-value added activity and hence a waste, MUDA.

Making of Yamazumi Chart

The first step is to carry out a time study of all process elements involved and record the time for standard job element and MUDA. For example, a finished product may require processes A to G, which may have time study as shown below:

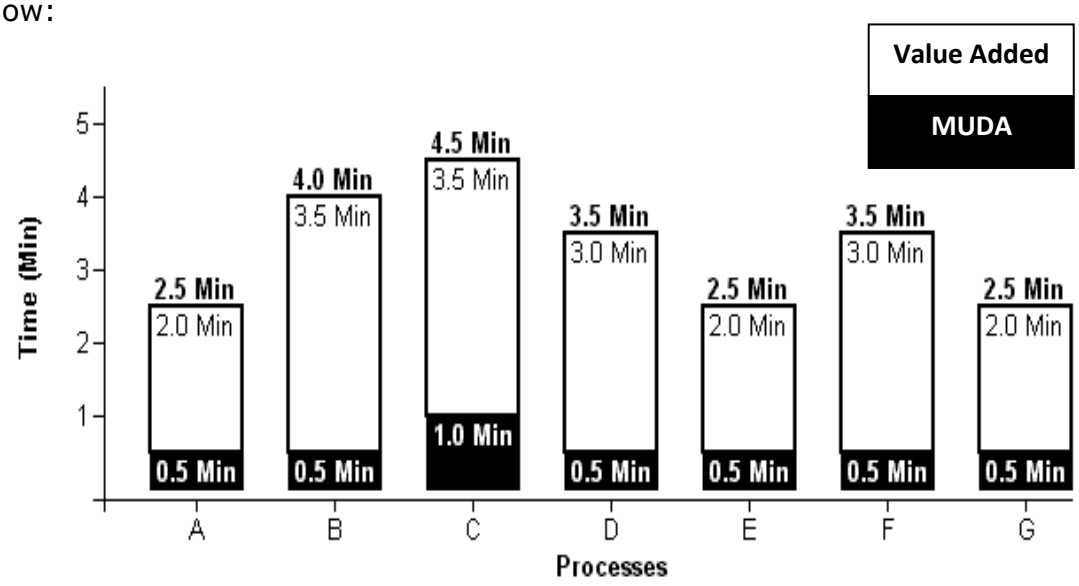
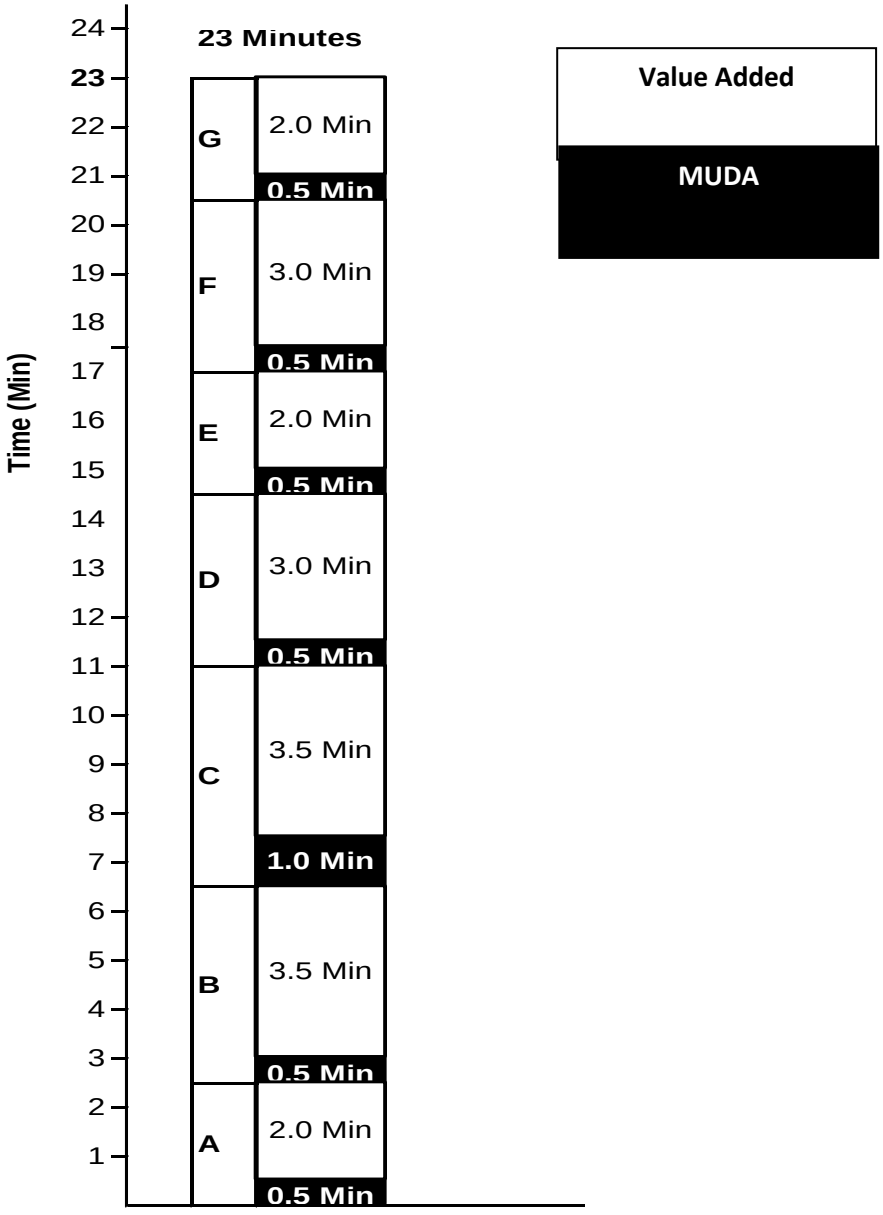


Figure 3: Making of yamazumi chart

The next step is to put these time elements one on top of the other to get the total time for the finished product. This is what is called a Yamazumi Chart.

Once this chart is made the value added activities & the non-value added activities are clearly visible for the entire process and concerted efforts can be made for reducing MUDA and rearranging processes so as to achieve required Takt Time say 8.5 Min/product.



A. Yamazumi Chart

Typical Case Study of Trim Line in Assembly Shop

The Trim line in assembly shop has 10 stations and the team member work on both left hand and right hand of the vehicle on conveyor making a total of 14 work stations as shown below:

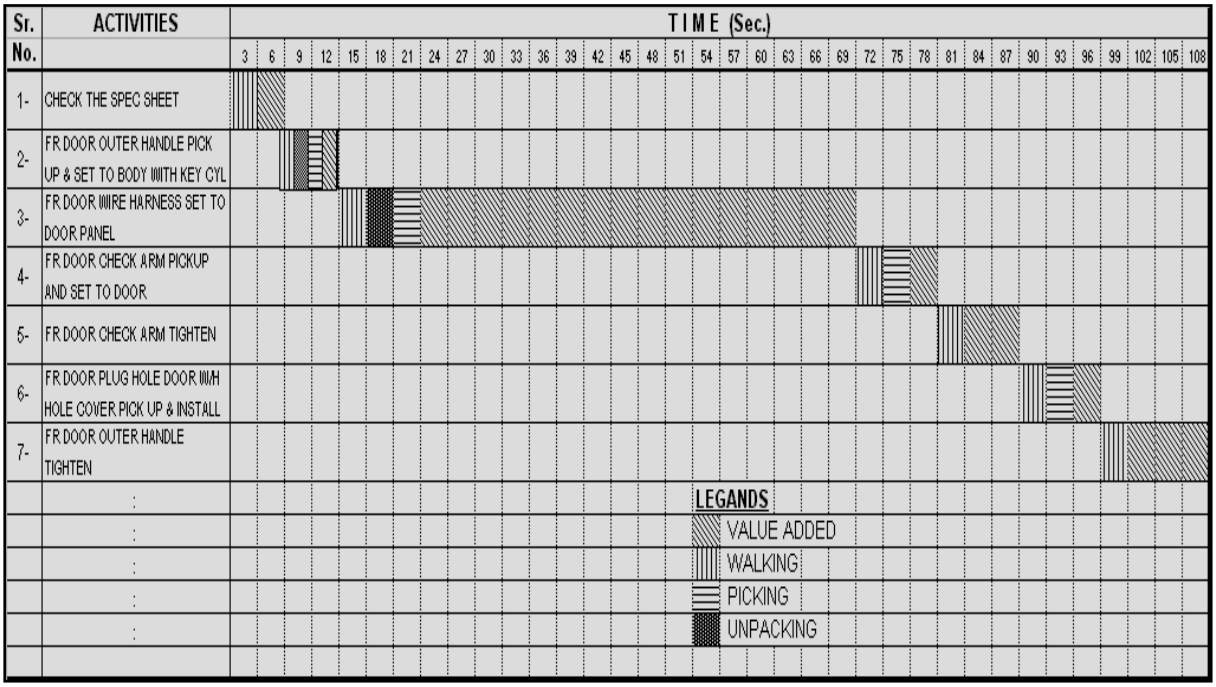
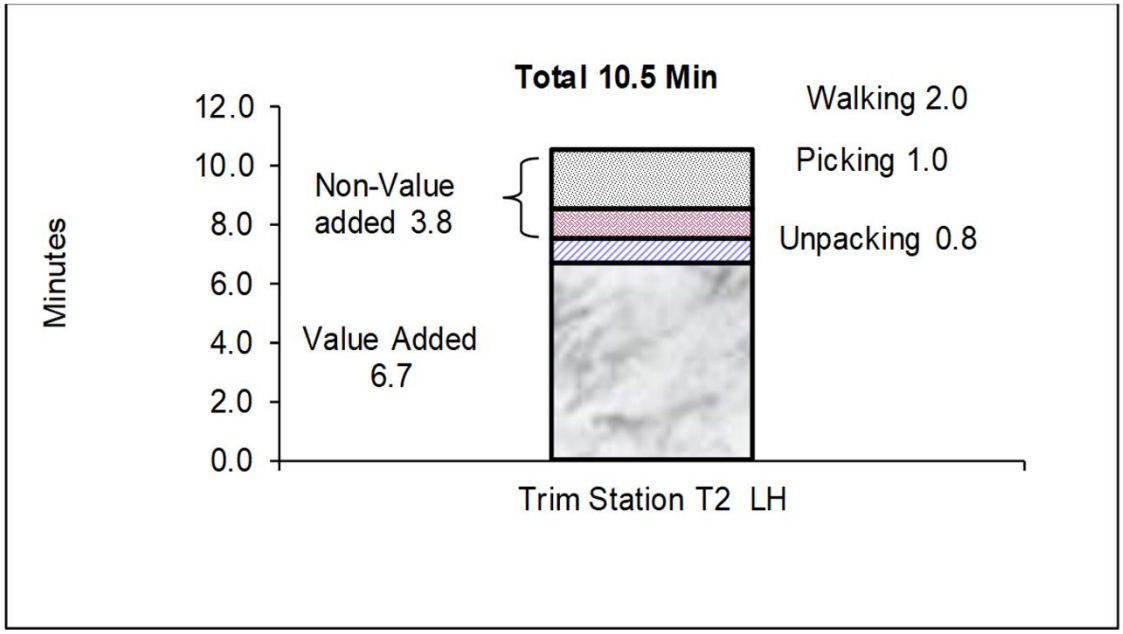


Figure 4: Timeline in assembly shop

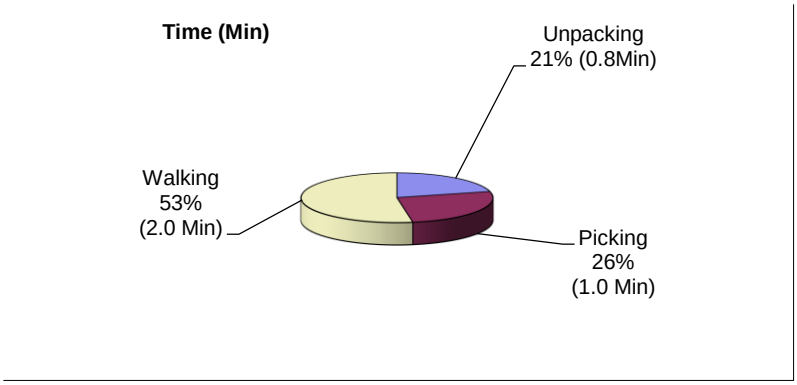
Taking a typical example of station No. 2 Left Hand (designated as T2, LH) there are 49 process elements done on this station. A careful Time Study of each process on this station revealed the following Graph showing time spent on Value added and non-value added activities.

Recording of Activities at T2 LH

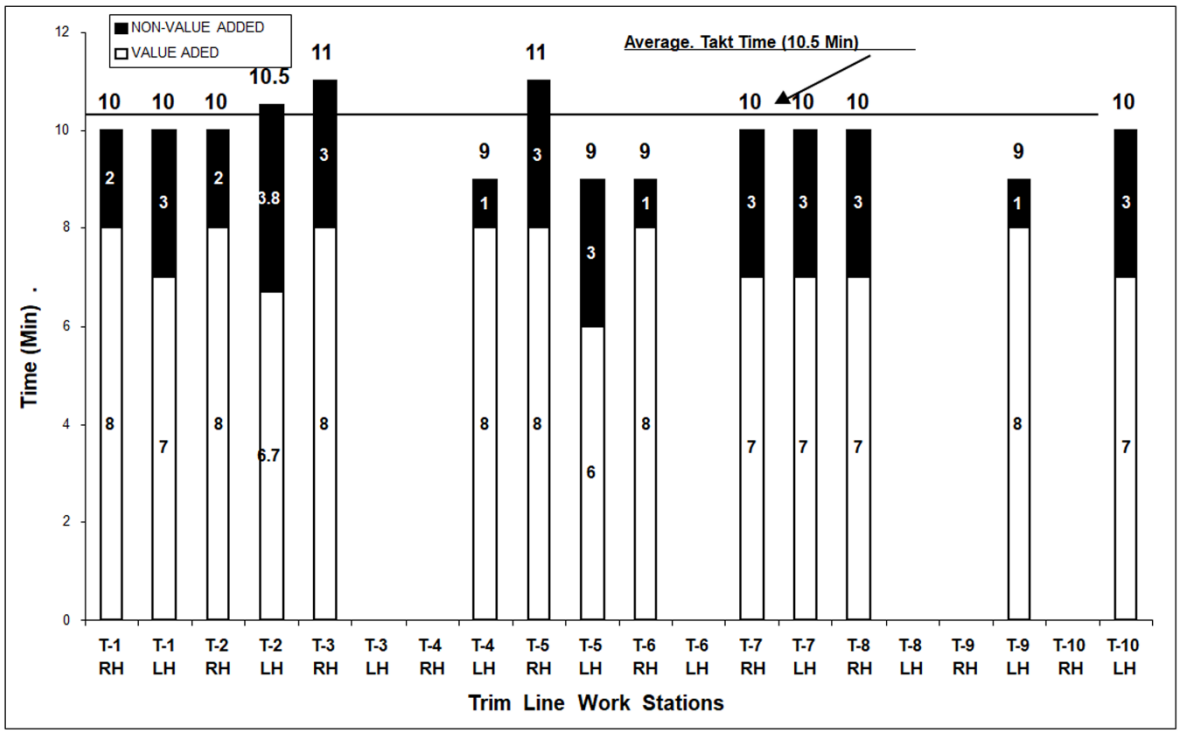
Only 7 process element/ activities are shown above and one can easily add up the time spent in non-value added activities for the 7 processes. When the total effect of 49 processes performed on this particular station is taken into consideration the picture emerges as shown below:



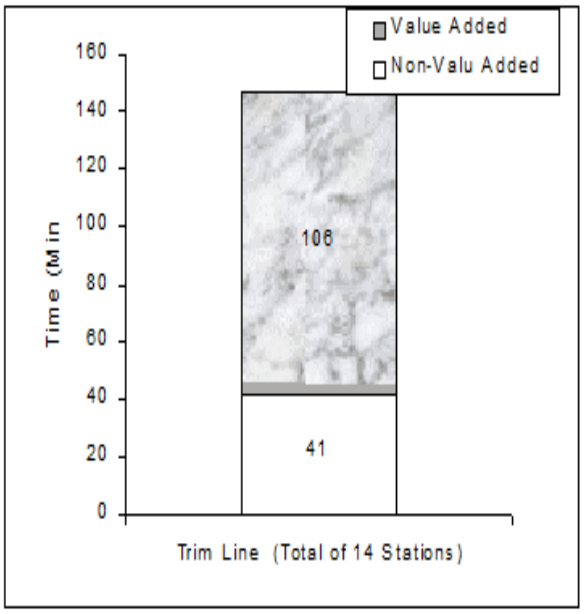
Thus out of 10.5 Min working on this station, 3.8 minutes (36%) is spent on non-value added activities of walking, unpacking & picking of parts. A further breakup of non-value added activities indicate that 53% time is spent in walking, 21% in unpacking & 26% in picking the parts as shown below:

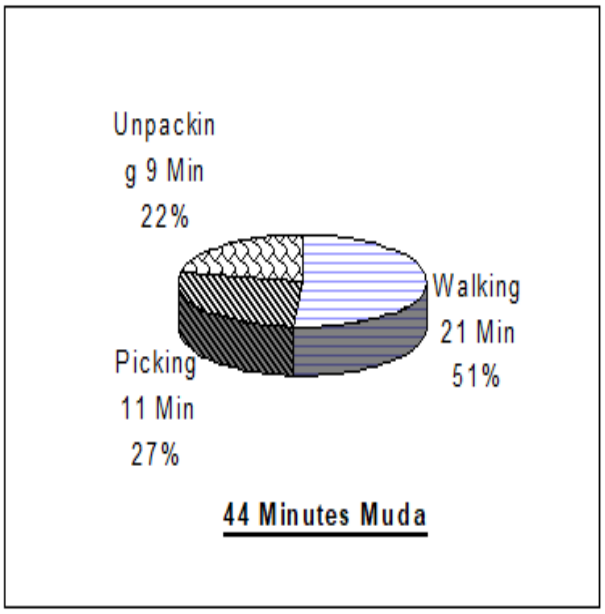


By conducting similar time study for all the 14 stations of Trim Line, the following picture emerged:



Thus out of a total 147 minutes of Trim line operation at 14 stations, 41 minutes were spent on non-value added activities, which was further analyzed as follows:





Steps Taken to Reduce MUDA

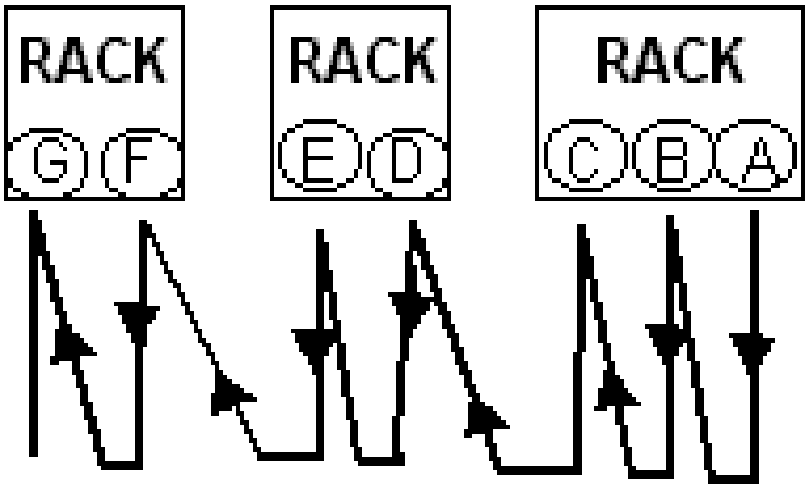
Reduction in Walking Time

51% of non-value added activity consists of walking by Team member for going to part rack for picking the part, bringing it to the vehicle, installing it and then going back to part rack for the next part. This movement was reduced by:

1. Reducing Picking frequency of parts from racks
2. Introduction of Movable Rack

Reduction in Picking Frequency/ Extra movement

It was observed that team members were in the habit of picking one part at a time from part rack, and after installing it in the vehicle would go to part rack for the next part. Thus if he is to pick up 7 parts A to G as shown in the sketch below, he will go and come back from the rack 7 times.

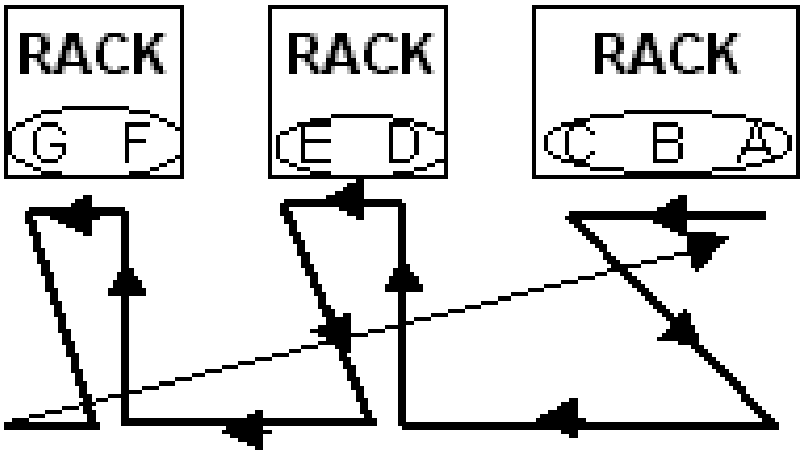


Before

Picking frequency was 7.

The team member was advised and trained to pick up as many parts as he conveniently can from the racks and put these in the vehicle and install the parts one after the other. Then for next picking, again pick up 2 or 3 parts and bring

these to vehicle for installation. This way as can be seen from the sketch below, the extra movement got reduced as the picking frequency got reduced from 7 to 3. By adopting this method a total saving of 7 minutes in walking time was observed.



Introduction of Moveable Rack

For small parts like grommet, washer, screws, etc., small trolleys were introduced which can be attached with the moving vehicle on conveyor as the vehicle approaches a work station. The simultaneous movement of trolley with vehicle enables team member to access the small parts without walking.

The above resulted the saving of one minute in Walking time

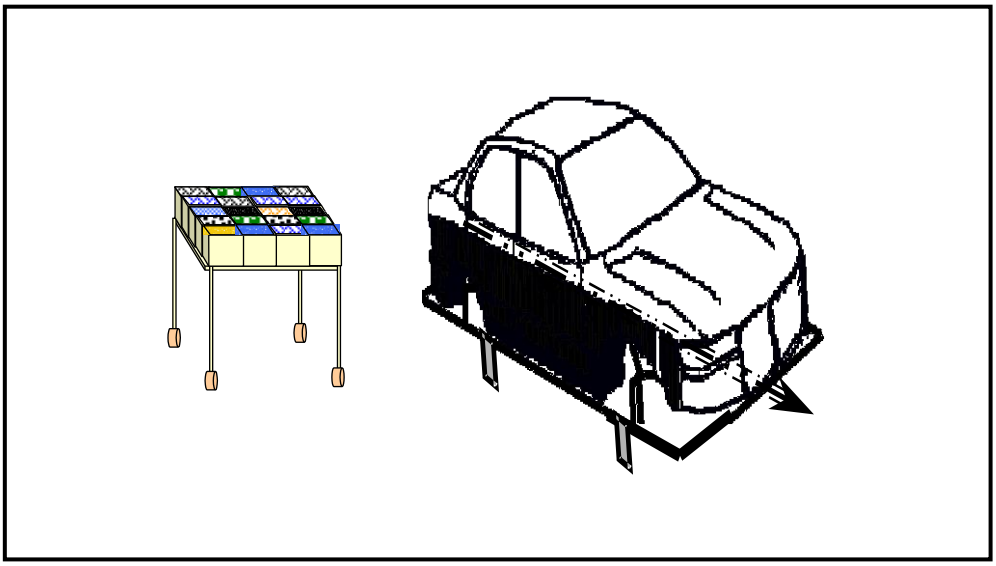


Figure 5: Movable Rack

Standardization of Walking

Standardization of walking was also done and each team member was given enough training to take 2 steps in 1.4 Sec. A saving of 4 minutes in walking time was observed as a result of this standardization in Trim Line.

Reduction in Picking Time

The following counter measure were taken to reduce the non-value added time spent in picking of parts:

Introduction of Flow Racks

A close observation of the motions/ actions of team member revealed that the parts rack available on line side had fixed shelves and often, if the size of the box containing the part is larger than the distance between the two shelves, the team members had difficulty in taking the part out of the part rack.

To reduce this problem, roller type racks were introduced in which the shelf height could be adjusted according to size of parts/ box. Because of the slight inclined angle and presence of roller, the next part becomes easily available due to gravitational flow to the team member after he picks up the first part as shown in the picture:

The Team members can make & modify easily these racks according to the part size and accessibility.

After introduction of Flow Racks, 5 minutes saving in pickup time was observed.

Introduction of Hardware & small part (Grommets, clips etc.) Racks

The non- availability of a quick means for identifying model wise hard wares and small parts (like grommet, clips etc.) was observed to be one of the major contributing factor for increasing MUDA in picking operation. Hence, hardware and small part racks were introduced with color-coded plastic boxes identifying respective models. As hardware grommets unpacked from polyethylene bags are poured in each color coded plastic box, having tag for part name & part numbers, the team members do not have to waste their precious time in identifying & segregating the appropriate hardware etc for the requisite model. The countermeasure brought saving of 2 minutes in pickup time.

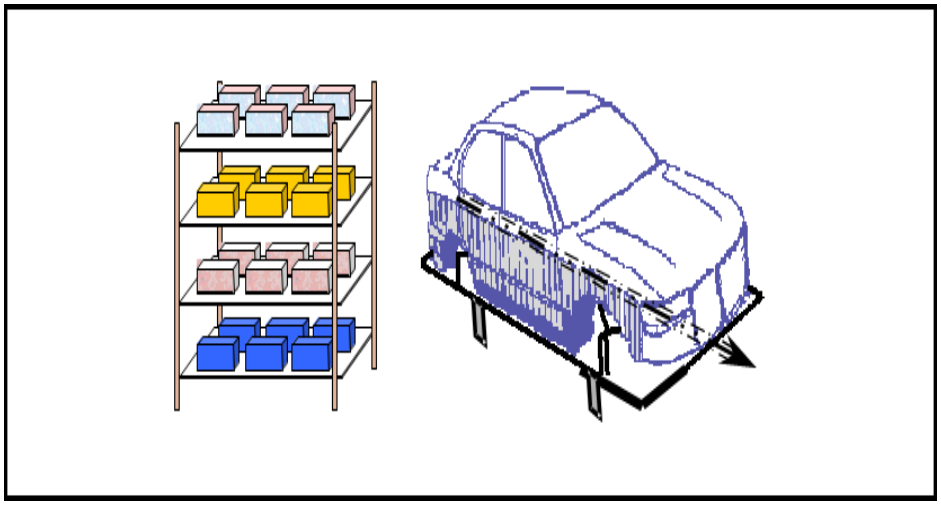
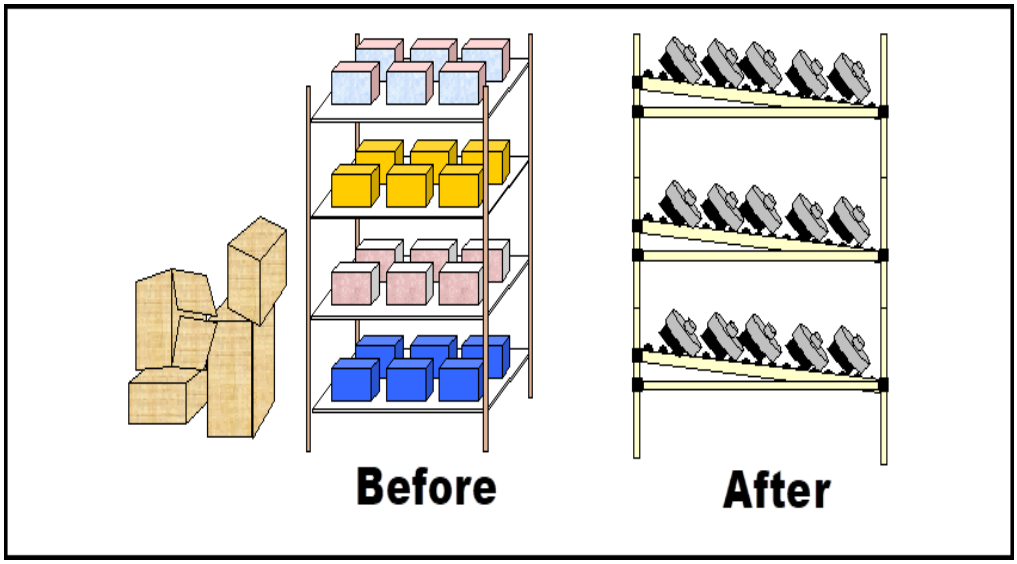


Figure 6: Hardware and small part

Minomi (Unpacked) Supplies

Team member's production time which was being wasted in opening of boxes/ polyethylene bags for unpacking of parts, was saved by asking PPMC department (Production Planning & Material Control department) to supply parts to line side racks in unpacked condition as shown below:



The introduction of Minomi supplies brought a saving of 5 minutes in unpacking time.

Summary of Improvement At Trim Line

The net effect of making Yamazumi Chart for Trim line and taking the above mentioned steps for reducing 3Ms, can be summarized as under:

The non-value added time reduced from 41 Minutes to 17 Minutes (a reduction of 58%).

The Takt time for each station reduced from 10.5-min/ vehicle to 8.5 min/ vehicle (a reduction of 23%)

As a result of above and by rearranging process elements, two working stations were eliminated from the trim line (Namely T9LH& T-5 RH) as shown below:
The consequent increase in production of Trim line was 30% with the same manpower thereby reducing man-hours per vehicle.

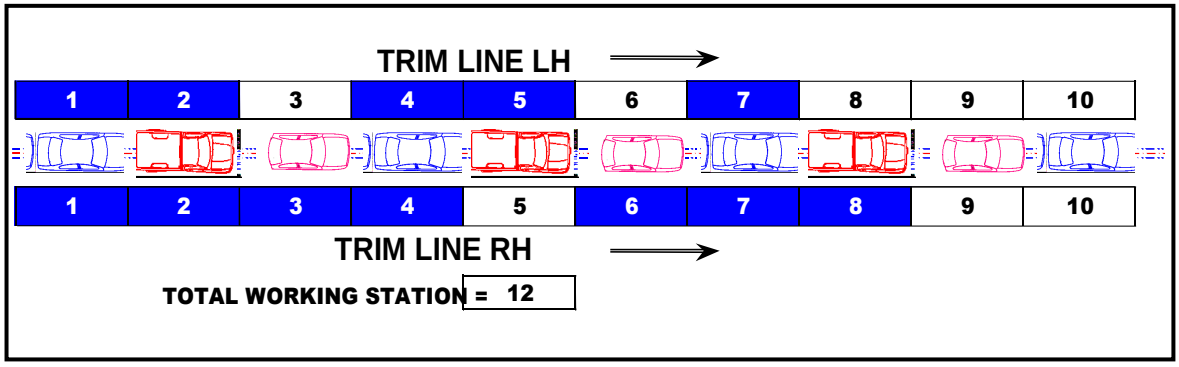


Figure 7: Trim line

YAMAZUMI Charts for Other Processes

The same exercise was conducted for each and every station of Weld shop, Paint shop, Engine shop, PPMC and Quality Assurance and everywhere there was identification and recognition of 3M's and everywhere when countermeasures were taken, the result was reduction in man-hours, and consequent decrease of Takt Time. As Toyota Production System is based on 'Pull' the Takt Time of the preceding station has to be the same as that of the following station. Consequently the entire plant got operated at 8.5 min. Takt time, increasing productivity by 26%.

Space Saving

The side effect of focusing on 3Ms' reduction resulted in space saving on shop floor. It appeared from a time study of each workstation that part racks should be as close to the vehicle as practically possible to reduce walking time. The

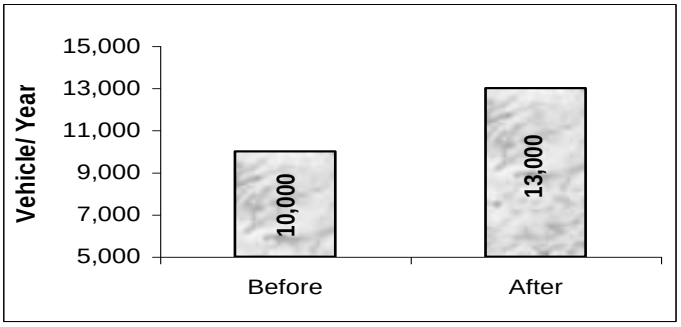
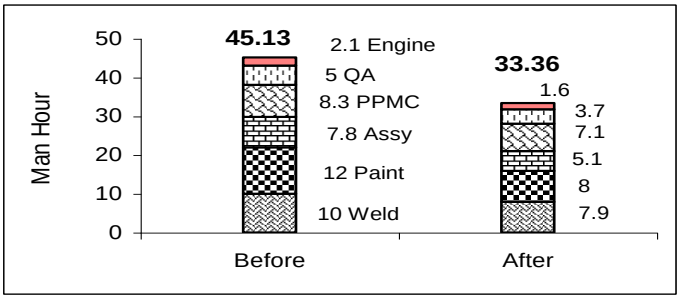
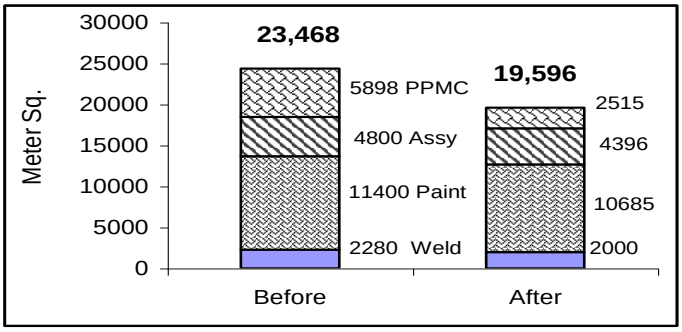
introduction of adjustable flow racks resulted in space saving on shop floor. Elimination of workstations resulting from careful study of 3Ms also reduced the workspace, which can be used for further expansion. It may be noted that TPS is also called lean production system i.e. lean in manpower, lean in equipment, and

also lean in space on shop floor. One technique adapted to save space on assembly line side was 'Jundate' (Sequential supply). Taking example of a bulky part like seat set or Fuel tank which requires a larger storage area on Shop floor, and if, for example, 3 models of vehicle are being produced, then a minimum quantity of these bulky parts will have to be present on line side, requiring lot of space. The solution was found in supplying the part of requisite model as is needed on the station. Thus the sequential supply system for bulky parts has reduced the required storage space on line.

Another glaring example of space saving done during this exercise was to rearrange CKD boxes in CKD warehouse such that the storage capacity increased to 44%. The previous arrangement of placing CD boxes could store 111 Lots (lot consists of 10 Units), but by making Yamazumi chart and doing Kaizen (continuous search for improvement), the same CKD warehouse can now store 160 lots. This is in fact 57% saving in space in CKD warehouse. Consequently, construction of a new CKD warehouse was avoided at the time of introduction of Daihatsu Cuore.

Result of Reducing 3Ms

The net result of focusing on reduction of 3Ms, at a Pakistani company practicing Japanese management, is shown below:

KEY AREA	NET RESULTS	STATUS BEFORE & AFTER
Production Capacity with Built-in-Quality as per TPS	Increase by 30% (3,000 Vehicles/ Year)	
Productivity (Man-Hour/ Vehicle)	Increase by 26% (Reduction of 12 M-hrs/Vehicle)	
Work Space (Meter Sq.)	Saving in space by 20% (4,782 M^2 space reduced)	

CONCLUSION

The strategies & techniques adapted at a Pakistani company practicing Japanese management, are based on Toyota Production System (TPS) and can be applied to other industries/ companies specially those involved in continuous assembly line. Preparation of a Yamazumi Chart is the first step towards elimination/ reduction of '3Ms'. The purpose of sharing this experience with others is to encourage them that with participative management, clarity of objectives, motivation and techniques of Toyota Production system, others can also achieve similar results & even better.