International Journal of Mechanical and Industrial Engineering

Volume 2 | Issue 4 Article 7

April 2013

A CASE STUDY ON IMPROVING THE PRODUCTIVITY USING IE TOOLS

BHAVIK SHAILESHKUMAR SHETH
International Institute of Information Technology, Pune, Maharashtra, India, shethbhavik23@gmail.com

TANMAY SWAROOP
Tata Motors Tata Technologies Ltd, 25 Rajiv Gandhi InfoTech Park, Pune, Maharashtra, India, tanmay.swaroop@tatatechnologies.com

RABINDER HENRY
International Institute of Information Technology, Pune, Maharashtra, India, rabinderh@isquareit.ac.in

Recommended Citation

SHETH, BHAVIK SHAILESHKUMAR; SWAROOP, TANMAY; and HENRY, RABINDER (2013) "A CASE STUDY ON IMPROVING THE PRODUCTIVITY USING IE TOOLS," *International Journal of Mechanical and Industrial Engineering*: Vol. 2 : Iss. 4 , Article 7.
DOI: 10.47893/IJMIE.2013.1105
Available at: https://www.interscience.in/ijmie/vol2/iss4/7

A CASE STUDY ON IMPROVING THE PRODUCTIVITY USING IE TOOLS

BHAVIK SHAILESHKUMAR SHETH, TANMAY SWAROOP & RABINDER HENRY

[1]Department-School of Interdisciplinary Science & Technology,
International Institute of Information Technology, Pune, Maharashtra, India
[2]Design Engineer, Tata Motors Tata Technologies Ltd, 25 Rajiv Gandhi InfoTech Park, Pune, Maharashtra, India
3HOD, Department-School of Interdisciplinary Science & Technology,
International Institute of Information Technology, Pune, Maharashtra, India
Email: shethbhavik23@gmail.com, tanmay.swaroop@tatatechnologies.com, rabinderh@isquareit.ac.in

Abstract: Assembly line balancing has been a focus of interest in Industrial Engineering for the last few years. Assembly line balancing is the problem of assigning tasks to workstations by optimizing a performance measure while satisfying precedence relations between tasks and cycle time restrictions. Line balancing is an important feature in ensuring that a production line is efficient and producing at its optimum. The process of Line balancing attempts to equalize the work load on each workstation of the production line. Mixed model assembly lines are increasing in many industries to achieve the higher production rate. This study deals with mixed-model assembly line balancing and uses Yamazumi chart to break down the work element in to the value added & Non-value added part to reduce the waste & increase the productivity.

Keywords: *Mixed model assembly line balancing, Mudas, Takt time, Yamazumi chart.*

1. INTRODUCTION

An assembly line is a set of sequential workstations linked by a material handling system. In each workstation, a set of tasks are performed using a predefined assembly process in which the following issues are defined: (a) task time, the time required to perform each task; and (b) a set of precedence relationships, which determines the sequence of the tasks. Line balancing operates under two conditions:

Precedence constraint: Product cannot move to other station if it doesn't fulfill requires task at that station. It should not across other station because certain parts need to be done before others.

Cycle Time Restriction: Cycle time is maximum time for products spend in every workstation. Different workstation has different cycle time and it depend upon the work of that particular station.

Constraint is defined as anything that limits the system from achieving higher performance relative to its purpose. Concept of TOC that every system must have at least one constraint and the existence of constraints represents opportunities for improvement.

TOC's 5-step process offers a systematic and focused process which organizations use to successfully pursue ongoing improvement:

The Five Focusing Steps

1. Identify the system's constraint
2. Decide how to exploit the system's constraint
3. Subordinate to the system constrains
4. Elevate the system's constraint
5. Don't allow inertia to become the system's constraint. When a constraint is broken, go back to step one

a) We used line balancing technique to achieve:

- The minimization of the number of workstations.
- The minimization of cycle time.
- The maximization of workload smoothness.
- The maximization of work relatedness.

For example, in the automobile industry, most of the models have a number of features, and the customer can choose a model based on their desires and financial capability Different features mean that different, additional parts must be added on the basic model. Due to high cost to build and maintain an assembly line, the manufacturers produce one model with different features or several models on a single assembly line. Under these circumstances, the mixed-model assembly line balancing problem arises to smooth the production and decrease the cost. Since the demands for different models and for features vary on a daily basis, the problem should be solved every day in industry. In mixed model line assembly models are launched to the line one after another. Two types of assembly line balancing problems are: 1. Type-I problems, where the required production rate (i.e. Cycle time), assembly tasks, tasks times, and precedence requirements will be given and the objective is to minimize the number of workstations; and 2. Type-II problems, where the numbers of workstations or production employees is fixed and the objective is to minimize the cycle time and maximize the production rate. These types of balancing problems are generally occur when the organization wants to produce the optimum number of items using a fixed number of workstations without purchasing new machines or expanding its facilities.

1.1 Lean Manufacturing

The use of the term "Lean", in a business or manufacturing environment describes a philosophy that incorporates a collection of tools and techniques into the business process to optimize time, human resources, assets and productivity, while improving the quality level of products and services to their customers.

Lean defines seven different types of waste that are tackled to minimize or eliminate them.

They are as follows:

Overproduction,
Extra-Processing,
Over Stocking,
Excessive Motion,
Defects and Rework

2. THE NEED

One of Automobile Company had plant capacity of producing 60,000 vehicles/ year. Company wants to launch the new model on same existing conveyor line. Work content of the new model is more compare to existing model. 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 increase of manpower on the other hand. So it was decided to increase the capacity by improving the productivity. In simple terms the production from 120 vehicle / day to 145 vehicle/day through reducing the Takt time from 10 minutes/ vehicle to 6.8 minutes / vehicle.

2.1 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

Each department / Section of Automobile company 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.

3. 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 making 4 seconds is a non-value added activity and hence a waste, Muda.

4. 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, which may have time study as shown below:

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.

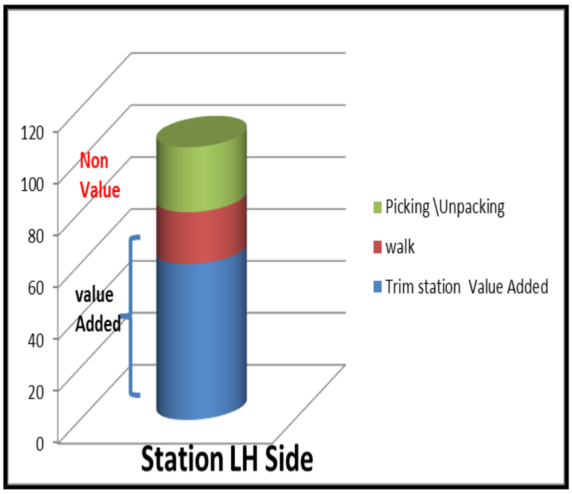

Fig.1 Yamazumi Chart

5. METHEDOLOGY

5.1 Typical case study of trim line in assembly shop

The trim line assembly shop has 11 stations and the worker work on the both left hand & right hand of the vehicle on the conveyer as shown in figure 2.

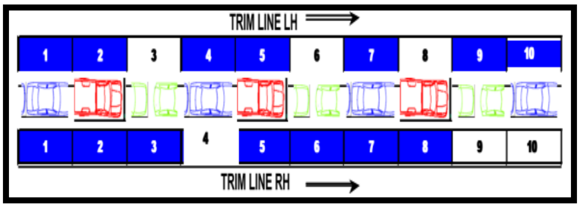

Fig.2 Trim line of GA shop

Take the example of the upcoming model is being manufactured on the existing assembly line. For that we have to balance the assembly line. In this case Master Trainers assemble and disassemble the car, learn the new methods of efficiently performing the works of the General Assembly shop. Based on several rounds of trials over a period of 6 months an array of arrangements are made to ensure that their implementation on the general line doesn't hamper the production of other models being built on the same line. However, this isn't always the case and so some modifications are made in order to accommodate the new model as well. After this the SOS (Standard operation sheet) of all the stations team wise are taken. Then the Master Trainers perform the activities as per the SOS. These activities are video recorded. And the timings are note down. If the Master Trainers face any problem or an issue is raised then it's also noted down for future correspondence. This cycle is repeated several times until the vehicle becomes "production ready". Proper workload distribution is essential to ensure lean manufacturing.

Each work element is divided into the following parts.

- Basic element content
- Work time
- Walk time
- Wait time

Taking a typical example of station No. 2 Left Hand there are 6 process elements done on the 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 (fig.3):

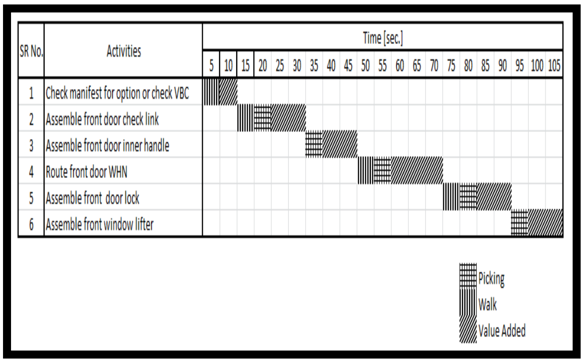

Fig. 3 Example of some activities of the LH side station

5.2 Steps taken to reduce muda

5.2.1 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:

- Reducing Picking frequency of parts from racks
- Introduction of Movable Rack

5.2.2 Reduction in Picking Time

As 27% of the non-value added time spent in picking of parts the following counter measure were taken to reduce the

Same:

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

5.3 MOST (Maynard operation Sequence Technique)

MOST (Maynard Operation Sequence Technique) is a work measurement technique developed by H. B. Maynard and Company. The concept of MOST is to analyze a job into its fundamental human activities, apply basic times for these from tables and synthesize them into a basic time for the complete job. The basic elements include the following:

- Reach for an object or a location.
- Get an object, touching it or closing the fingers around it.
- Move an object a specified distance to a specified place.
- Release an object to relinquish control on it

For each of these actions basic times are tabled in MOST.

MOST is a powerful analytical tool that helps increase productivity, improve methods, facilitate planning, establish workloads, estimate labor costs, improve safety, and maximize resources, MOST can be applied to any type of work for which a method can be defined and described.

6. YAMAZUMI CHARTS FOR OTHER PROCESS.

The same exercise was conducted for each and every station of weld shop, paint shop, general assembly shop 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-hour, and consequent decrease of Takt Time.

Takt time is the time in which a unit must be produced in order to match the rate of customer demand.

Figure 4 shows the unbalanced situation of some station before line balancing.

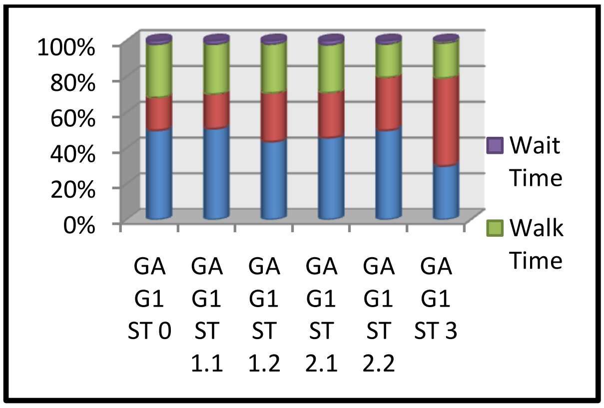

Fig. 4 YAMAZUMI chart before line balancing

Identify the area on which the work load is more and then transfer the activities to the other station.

Figure 5 shows the condition of the stations after the line balancing.

Key Area		Before	After
Productivity (Man-power Requirement)	Trim line	33	28
	Chassis line	36	30
	Total	69	58

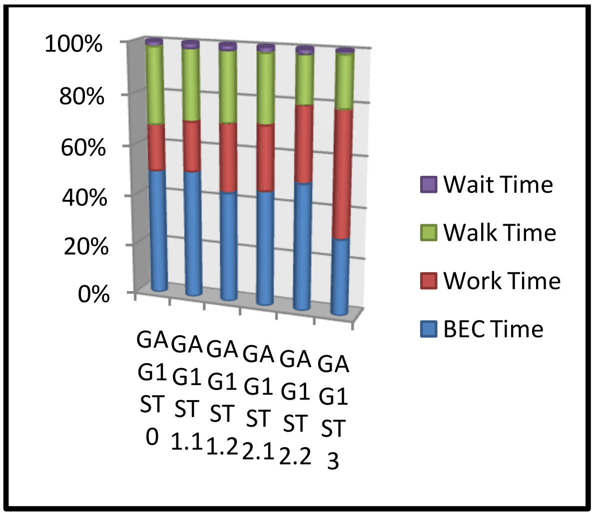

Fig. 5 YAMAZUMI chart after line balancing

After Line balancing take consideration of the constraint regarding material movement, line space constrains, Station constrains, man-power constrain002E And try to improve the Line Efficiency & Element Utilization. (Fig. 6)

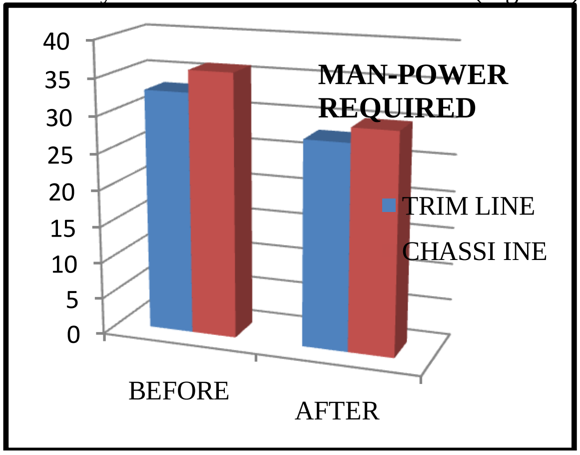

Fig. 6 Comparison of man power requirement before and after line balancing

7. CONCLUSION

The strategy & techniques adapted at Automobile Company were based on Toyota Production System (TPS) and can be applied to other companies especially those involved in continuous assembly line. After doing mixed model line balancing by mutation & cross over operation between team & station with considering all constraint & precedence relationship. 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 The man-power requirement reduced from 69 to 58 only in the general assembly shop. Also increase the man-power utilization on average from the 60% to 80 %.

REFERENCES

[1]. Introduction to work study, By M.N.Pal, third edition, OXFORD & IBH Publication CO.PVT.LTD, New Delhi

[2]. "U-shaped assembly line layouts and their impact on labor productivity: An experimental study", Gerald R.Aase, John R.Olson, Marc J.Schniederjans, European Journal of Operational Research 156 (2004) 698–711

[3]. CASE STUDY : PRODUCTIVITY ENHANCEMENT AT INDUS MOTOR CO. LTD. THROUGH FOCUSING ON 3M'S Muri (Over Burden), Muda (Non Value Added), Mura (Unevenness) by M. Mohiyuddin General Manager, (Production & Prod. Engg.), Indus Motor Company Ltd.

[4]. "Re-balancing of Generalized Assembly Lines – Searching Optimal Solutions for SALBP", Chowdury Md. Luthfur Rahman International Conference on Industrial Engineering and Operations Management Dhaka, Bangladesh, January 9 – 10, 2010

[5]. Emanuel Falkenauer "Line Balancing in the Real World" International Conference on Product Lifecycle Management

[6]. Erdal Erel & Subhash C. Sarin "A survey of the assembly line balancing procedures",

◈◈◈