Improving Efficiency of Assembly Line by Line Balancing Technique & Automation

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Abstract: Assembly lines are the most important components of mass production systems. The unequal workload among workstations of assembly line increases work in progress (WIP) and waiting time of manpower and machines. This paper focuses on line balancing of a manufacturing industry assembling Automotive seats. The prime objective of line balancing is to distribute tasks evenly over the workstations to minimize the idle time. The project aims towards Line balancing technique for improving the efficiency and use of automation technique to reduce the work content with major scope of improvement in assembly line in terms of manpower and quality. In this study, lean manufacturing techniques are used for improving efficiency of existing assembly line for new improved model of FCA program which includes volume increase by 50%. At the beginning of the study, information about the number of stations, line efficiency, and cycle time of the existing assembly line have been gathered. The line efficiency of the existing assembly line was only 82.73 % with production capacity of 75 car sets per shift. The cycle time and number of workstations have been rationalized. The cycle times have been reduced from 6 to 4 minutes and output of existing seat assembly line has been increased from 10 JPH to 15 JPH. The efficiency increased from 82.73% to 91.75%. The designed line has the capability to assemble 113 car sets per shift without any overtime, with lesser number of labors and machines. Additional to other benefits, the designed assembly line will fulfill increased customer demand & save labor and operating costs per month.

Keywords: *Takt time, Volume per shift, Line balancing, Work in Progress (WIP), Cycle Time, Line Efficiency, Idle time, Bottleneck operations.*

1. Introduction

Line balancing techniques apply to production and assembly lines for equal distribution of workload across the lines. It emphasizes on reducing the waste related to waiting, motion, transportation time, and WIP inventory. It ensures a smooth and an undisrupted flow of materials across the line by assigning equal workloads to the workstations.

The total work contents in an assembly line are broken into individual work elements known as work tasks. The precedence relationships among these tasks need to be carefully considered while using line balancing techniques. Each task requires a specific time for its completion which is known as standard time of the task. The standard time of tasks can be determined by using time study techniques. The collective standard time for all tasks is called as total work contents of the line. It is the time for a product to process through all stations in the assembly line. The actual time necessary for an operator to perform total work content at each workstation called cycle time. If the process time at a workstation is more than or less than cycle time, this indicates bottlenecks in the assembly line which will result delay in fulfilling customers demand.
The two terms cycle time and takt time have different meanings for different researchers. Some researchers have called the two as a gap between two successive products coming out of work station. However, some authors have used both terms in different meanings. Cycle time represents the actual time necessary for an operator to perform an activity while takt time represents the maximum time allowed to meet the customers demand. The meaning of both terms will remain similar everywhere in this study as both cycle time and takt time are determined by customer demand.
In this paper, a case study of a multi-national manufacturing organization has been presented. The organization has model assembly line assembling "Automotive Seats". The industry has huge bottlenecks and idle time along the assembly line. Unequal tasks distribution among the work stations could be one of the main reasons for the bottlenecks in the assembly line. In competitive automotive Industry, the Tier-1 suppliers needs to give improvement and cost savings to customers, even quality improvement in product helps to get new projects. The organization working for Improvement of

Carryover project FCA-Jeep Compass has focus on Lean Manufacturing technique and Continuous improvement in new improved model of this program which includes volume increase in the project by 50%.

In this competitive environment the major costs i.e., consumable cost and labor cost. The customer needs optimized cost and improved quality. This can be achieved by automation techniques and lean manufacturing. The researcher will also design an optimum layout, manpower required, and equipment's required for achieving the target in an effective and efficient manner.

This paper has been organized in separate sections as follows. It has been started with a brief introduction followed by a thorough literature review of the problems, types and methods of Assembly Line Balancing (ALB). In the next section, we have discussed briefly each methodology and technique applied in the study. This section, which covers research methodologies has provided direction to our research work. In section 4, we have presented the primary results with the possible explanations and meaningful discussion. In the last section before providing citation, we have summarized and concluded the study.

2. Literature Review

Assembly line (AL) concept was first presented by Henry Ford in early 1900's. It is a cost efficient, highly productive way used by manufacturing organizations. It reduces the waiting time of manpower and machines by assigning equal work load to each station along the line. Assembly line balancing (ALB) sets to reduce the possibility of disruption of production line. It makes the flow efficient, cost effective and increases production rate of assembly line.

Assembly line balancing (ALB) is the act of assigning the tasks to the workstations by optimizing the pre-specified objective function without violating the precedence constraints. ALB that produces a single model is referred to as a simple assembly line balancing problem (SALBP). Based on the objective functions the SALBP can be categorized as Type I, Type II and Type III. Type I problems minimize the number of workstations given a prespecified cycle time. The cycle time is defined as the time between the completion times of two successive product units. Type II problems minimize the cycle time, hence maximize the production rate, given a prespecified number of workstations. Type III problems maximize the work-load smoothing (balancing), hence try to attain similar workstation loads. In this case study, Type III problems have been addressed.

Line-balancing strategy is to make production lines flexible enough to absorb external and internal irregularities. There are two types of line balancing, which we have explained as:

1. Static Balance – Refers to long-term differences in capacity over a period of several hours or longer. Static imbalance results in underutilization of workstations, machines and people.
2. Dynamic Balance – Refers to short-term differences in capacity, like, over a period of minutes, hours at most. Dynamic imbalance arises from product mix changes and variations in work time unrelated to product mix.

Line balancing operates under two circumstances:

1. Precedence Constraint: Products cannot progress to other station if it doesn't complete necessary task at that station. It should not across other station because certain part needs to be performed before other activities.
2. Cycle time Restriction: Cycle time is maximum time for products spend in every workstation. Different workstation has different cycle time

Following are major objectives of Line balancing procedure. It is used to:

1. Manage the workloads among assemblers.
2. Recognize the location of bottleneck.
3. Decide number of workstations.
4. Decrease production cost.
5. Assigning task to each work station in such a way that there is little idle time

3. Research Methodology

3.1 Outline of the Problem: -

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The Organization is supplying automotive Seats for Program 556-Jeep Compass. As the customer demand is increased, the output is required to increase. They require low cost automation on assembly line for improving the quality, also due to bottleneck operations organization needs to run assembly line in overtime.

3.2 Objectives of project:

1. To increase output of existing seat assembly line to 15 jobs per hour.
2. To identify the bottlenecks of assembly line.
3. To calculate line efficiency of assembly line through line balancing
4. To calculate number of workstations required.
5. To Reduce the worker idle time.
6. To ensure timely delivery of product to customer.

3.3 Research Design and Methodology:

3.3.1 Type of research in project

Quantitative research is expressed in numbers and graphs. It is used to test or confirm theories and assumptions. This type of research can be used to establish generalizable facts about a topic.

3.3.2 Quantitative methods used in data collection

Data is collected from shop floor of FCA-556 Project 1st Row seat assembly from the records, personal observations is done and discussion from the seniors were carried out

4. Analysis and Interpretation of data

4.1 Program Details:

Fig 1. Jeep Compass

Program Code: FCA 556
OEM: FCA-Fiat Chrysler, Ranjangaon
Program Country: India, Vietnam, South Africa
Manufacturing Plant: Fiat Ranjangaon, Pune
Yearly Volume: 43,200 Cars/ Year
No. of Shift: 2 shifts/ day
No of Rows: 2 Rows

4.2 Existing Layout of 1st Row Assembly Line:

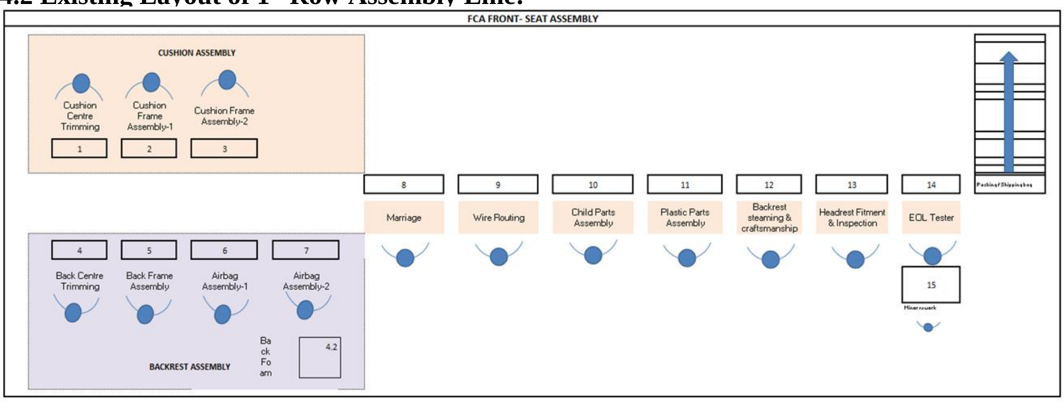

Fig 2. Existing Assembly Line Layout

4.2.1 Calculations:

Volume Per Year: 43,200 Car sets Per Year
Working Days Per Year: 288 Days
Working Shifts per Day: 2 shifts

$$\text{Volume Per Shift} = \frac{\text{Volume per year}}{\text{Working days per year} \times \text{Working shifts per day}}$$

$$\text{Volume Per Shift} = \frac{43200}{288 \times 2}$$

$$\textbf{Volume Per Shift} = \textbf{75 Carsets}$$

i) Available Time Per Shift= (8 hours-0.5 hours for lunch) =7.5 Hours

$$\text{Takt Time} = \frac{\text{Available Time Per Shift}}{\text{Volume Per Shift}}$$

$$\text{Takt Time} = \frac{7.5}{75}$$

Takt Time = 0.1 Hours = 0.1 x 60=6 Minutes

4.2.2 Existing assembly line station cycle times:

Station Number	Station Name	Station Time in seconds	Station time in minutes	Manpower
1	Cushion Centre Trimming	152	2.5	1
2	Cushion Frame Assembly-1	240	4.0	1
3	Cushion Frame Assembly-2	232	3.9	1
4	Back Centre Trimming	348	5.8	1
5	Back Frame Assembly	352	5.9	1
6	Airbag Assembly-1	450	7.5	2
7	Airbag Assembly-2	206	4.3	1
8	Marriage	216	3.6	1
9	Wire Routing	450	7.5	1
10	Child Parts Assembly	330	5.5	1
11	Plastic Parts Assembly	280	4.7	1
12	Backrest steaming & craftsmanship	345	5.8	1
13	Headrest Fitment & Inspection	290	4.8	1
14	EOL Tester	280	4.7	1

Table 1. Existing assembly line station cycle times

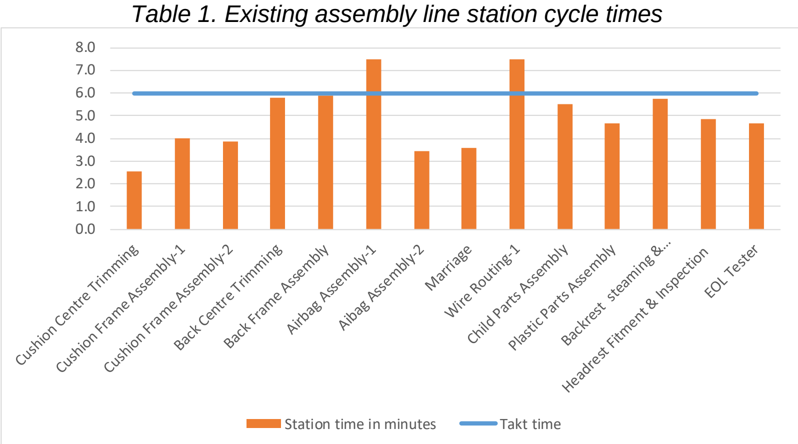

Fig 3. Relation between Existing assembly line cycle times Vs Takt Time

$$\text{Line Efficinecy} = \frac{Sum\ of\ all\ task\ times}{No.of\ workstations \times Takt\ time}$$

$$\text{Line Efficinecy} = \frac{69.5\ minutes}{14 \times 6\ minutes} x100$$

$$\text{Line Efficinecy} = 82.73\ \%$$

4.3 Proposed Condition:

i) **Volume Per Year:** 64,800 Car sets Per Year
Working Days Per Year: 288 Days
Working Shifts per Day: 2 shifts

$$\text{Volume Per Shift} = \frac{Volume\ per\ year}{Working\ days\ per\ year \times Working\ shifts\ per\ day}$$

$$\text{Volume Per Shift} = \frac{64800}{288 \times 2}$$

Volume Per Shift = 112.5 Car sets = 113 Car sets

ii) Available Time Per Shift= (8 hours-0.5 hours for lunch) = 7.5 Hours

$$\text{Takt Time} = \frac{Available\ Time\ Per\ Shift}{Volume\ Per\ Shift}$$

$$\text{Takt Time} = \frac{7.5}{113}$$

Takt Time = 0.0663 Hours = 0.0663 x 60=3.99 Minutes=4 Minutes

iii) No. of Stations required

$$\text{No. of Stations Required} = \frac{\sum Total\ Task\ Times}{Takt\ Time} = \frac{69.5}{4}$$

$$\textbf{No. of Stations Required} = \mathbf{17.3 = 17}\ \boldsymbol{Stations}$$

As per new volume received, Number of stations required are 17 but currently only 14 station are available. therefore, existing bottleneck operations need to be divided into additional stations.

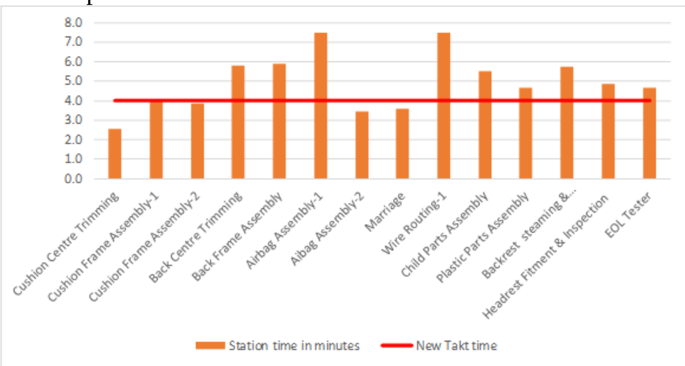

Fig 4. Relation Between Station Cycle Time Vs. Takt Time with updated Takt time

4.4 Bottlenecks Identification:

Operations with cycle time more than Takt time:

i) Back Centre Trimming
ii) Back Frame Assembly
iii) Airbag Assembly- Bottleneck
iv) Wire Routing-Bottleneck
v) Child Part Assembly
vi) Plastic Parts Assembly
vii) Back Rest Steaming
viii) Headrest Fitment and Inspection
ix) EOL Tester

4.5 Cycle Time breakdown of existing back centre trimming and back frame assembly stations:

Station	Operation	Time In secs	Total
Back Centre Trimming	1 Take back foam as per variant and place it over the table	10	348
	2.Scan Build ticket label for seat.	5	
	3.Take Heater mat, scan barcode for mat and ensure component match.	5	
	and Paste heater mat on back foam. (acc to variant)	52	
	4.Take back duct vent and paste on back side of foam (acc to variant)	25	
	5.Take back trim cover and scan Barcode to ensure component match.	5	
	6. Do c-ring fitment with foam to trim cover by hog ring gun.	63	
	7.Wrap & pull the trim cover over the foam.	58	
	8. Check for OK quality and move it to next.	15	
	1) take tootsie foam and place it on table.	8	
	2) take tootsie trim and insert the foam into the trim.	26	
	3)use bone to properly adjust the foam inside the trim.	46	
	4)enclose the trim by j-stripping.	30	
Back Frame Assembly (Dr + Co-Dr)	1 Take back frame as per variant,	10	352
	3.Scan bar code label for Back frame and ensure component match.	7	
	7. Take lumbar static and do assembly of Lumbar with back frame by engaging lumbar hooks at proper locations and fix by cable tie	40	
	4. Take harness wire and scan bar code label.	10	
	5. Do assembly of Wire Harness with Back frame by proper routing at specified locations.	40	

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	8.Tale lumbar power and scan bar code of lumbar to ensure component match.	15	
	9.Make assembly of Lumbar with back frame.	25	
	10. apply felt tape at the back-frame edge so as to protect power lumber pipe, also apply felt tape to the power motor to protect it from lumber wire friction.	50	
	11.attach expansion nut at the square section of the back frame top edge, (2 Qty).	25	
	10.Take blower for back and make assembly with expansion nut by fixing 2 no of Nuts. (2.5 Nm±0.25)	40	
	11.Take Back Foam Trim assembly and insert over Back.	90	

Table 2. Cycle Time breakdown of existing back Centre trimming and back frame assembly stations

4.5 Proposed New Station to split back centre trimming and back frame assembly stations:

Station	Operation	Time In secs	Total Time
Back Centre Trimming	1 Take back foam as per variant and place it over the table	10	238
	2.Scan Build ticket label for seat.	5	
	3.Take Heater mat, scan barcode for mat and ensure component match.	5	
	and Paste heater mat on back foam. (acc to variant)	52	
	4.Take back duct vent and paste on back side of foam (acc to variant)	25	
	5.Take back trim cover and scan Barcode to ensure component match.	5	
	6. Do c-ring fitment with foam to trim cover by hog ring gun.	63	
	7.Wrap & pull the trim cover over the foam.	58	
	8. Check for OK quality and move it to next operation	15	
New Station Back Centre Trim + Frame Pre-assembly	1) take tootsie foam and place it on table.	8	232
	2) take tootsie trim and insert the foam into the trim.	26	
	3)use bone to properly adjust the foam inside the trim.	46	
	4)enclose the trim by j-stripping.	30	
	1 Take back frame as per variant,	10	
	3.Scan bar code label for Back frame and ensure component match.	7	
	7. Take lumbar static and do assembly of Lumbar with back frame by engaging lumbar hooks at proper locations and fix by cable tie	40	
	4. Take harness wire and scan bar code label to ensure component match	10	
	5. Do assembly of Wire Harness with Back frame by proper routing at specified locations.	40	
	8.Tale lumbar power and scan bar code of lumbar to ensure component match.	15	
	9.Make assembly of Lumbar with back frame.	25	
Back Frame Assembly	10. apply felt tape at the back-frame edge so as to protect power lumber pipe, also apply felt tape to the power motor to protect it from lumber wire friction.	50	230
	11.attach expansion nut at the square section of the back frame top edge, (2 qty).	25	
	10.Take blower for back and make assembly with expansion nut by fixing 2 no of Nuts. (2.5 Nm±0.25 Nm)	40	
	11.Take Back Foam Trim assembly and insert over Back Frame.	90	

Table 3. Cycle Time breakdown to split back Centre trimming and back frame assembly stations into new station

4.6 Cycle Time breakdown of existing Wire Routing station:

Station	Operation	Time In secs
wire routing-1	wire routing backrest frame	220
	wire routing cushion frame	230

Table 4. Cycle Time breakdown of existing Wire Routing station

4.7 Proposed Splitting Wire routing station into 2 stations:

Station	Operation	Time In secs
wire routing-1	wire routing backrest frame	220
wire routing-2	wire routing cushion frame	230

Table 5. Cycle Time breakdown of Wire routing station into 2 stations

4.8 Airbag Assembly Station:

Existing Airbag Assembly is done on the simple workstation as below:

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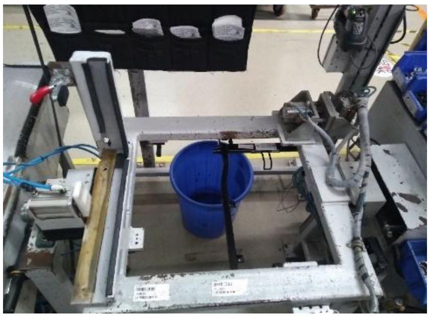

Fig 5. Existing Airbag Assembly Station-1

4.8.1 Existing Cycle Time of Airbag Assembly Station-1:

Station	Operation	Time in Seconds	Total Time
Air Bag Assembly-1	take scanner, scan airbag & verify	8	450
	insert airbag into the pocket, locate the holes & insert studs into the hole	150	
	adjust the pocket for airbag icon/sticker	12	
	connect the wire harness to the airbag	15	
	take nuts do the pre-tightening	20	
	take dc tool, do the tightening, keep back the tool	30	
	do the zipping left and right + massaging	70	
	do the veil crow operation + massaging	40	
	do the j-strip operation + massaging	75	
	properly massaging	30	

Table 6. Cycle Time breakdown of Existing Cycle Time of Airbag Assembly Station-1

Observation:

1. For inserting airbag into the pocket and inserting studs inside packet is taking more than 150 seconds for average skilled worker.
2. Also, 1 separate manpower required to hold the back frame in correct position for assembly of airbag.
3. Also, Zipping and J-strip operation taking time due to not proper holding of fixture.

Suggestions :

So, we can implement fixture for holding the back frame, also provide the pneumatic operated mechanism for tilting the back frame at particular angle.

4.8.2 Proposed New fixture airbag assembly station-1:

x) Reducing the manpower by holding backrest frame.
xi) Reducing the work content by proper positioning of tools
xii) Improving the quality of work.

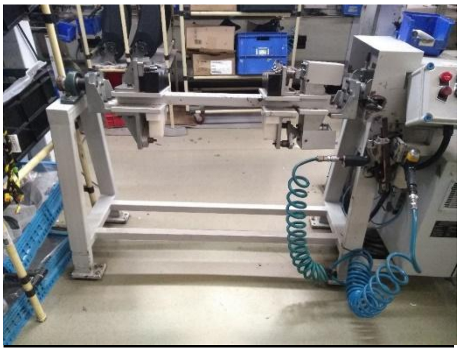

Fig 6. New Airbag Assembly Station-1

Station	Operation	Time in Seconds	Total Time
Air Bag Assembly-1	take scanner, scan airbag & verify	8	230
	insert airbag into the pocket; an insert the studs	20	
	adjust the pocket for airbag icon/sticker	12	
	connect the wire harness to the airbag	15	
	take nuts do the pre-tightening	20	
	take dc tool, do the tightening, keep back the tool	30	
	do the zipping left and right + massaging	30	
	do the veil crow operation + massaging	20	

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	do the j-strip operation + massaging	45	
	properly massaging	30	

Table 7. Cycle Time breakdown of Proposed Airbag Assembly Station-1

4.9 Existing Cycle time of Child part Assembly, Plastic part assembly and Steaming:

Station	Operation	Time in Seconds	Total Time
Child Parts Assembly	1.Take Marriage assembly of Cushion & Back from previous station.	10	330
	2.Take remote handle and engage into recliner hub at h point.	30	
	3.Make fitment of remote handle by 1 no. of screws by DC tool Torqueing (4 Nm±0.4 Nm)	85	
	4.Take remote release handle and make assembly with cushion Frame.	35	
	5.take remote release lever and attach it to the frame stud and twisting it in the release handle.	20	
	6.attach clip to the remote release lever.	20	
	5.Take Wire release handle and attach one end onto release lever and other into remote handle.	38	
	8.Check for OK quality and move it to next operation.	32	
	pallet rotation allowance	60	
Plastic Parts Assembly	1.attach switch to the outer shield according to the variant.	30	280
	2.Take side shield inboard and outboard (1 each) and make fitment acc to variant.	30	
	3. Take HA lever (1 qty) and make fitment using screw runner and 3 screws. (IB 2 screws OB 1 screw - Side shield Attachment M4.2X1.41X9.6 SCREW, TAPPING, ROUND, WASHER (QTY - 3)) torque 2.5nm)	20	
	4.attach HA cap to the knob.	30	
	5. Take recliner knob (1qty) and make fitment with remote release lever.	38	
	6. Check for OK quality and move it to next operation	20	
	pallet rotation allowance	112	
Steaming and Craftsmanship	1.Steaming	107	345
	2.Piping	238	

Table 8. Cycle Time Breakdown of Existing Child part Assembly, Plastic part assembly and Steaming

4.10 Child Part assembly, plastic part assembly and steaming, new station included:

Station	Operation	Time in Seconds	Total Time
Child Parts Assembly	1.Take Marriage assembly of Cushion & Back from previous station.	10	238
	2.Take remote handle and engage into recliner hub at h point.	30	
	3.Make fitment of remote handle by 1 no. of screws by DC tool Torqueing (4 Nm±0.4 Nm)	85	
	4.Take remote release handle and make assembly with cushion Frame.	35	
	5.take remote release lever and attach it to the frame stud and twisting it in the release handle.	20	
	6.attach clip to the remote release lever.	20	
	5.Take Wire release handle and attach one end onto release lever and other into remote handle.	38	
Plastic Parts Assembly	8.Check for OK quality and move it to next operation.	32	240
	pallet rotation allowance	60	
	1.attach switch to the outer shield according to the variant.	30	
	2.Take side-shield inboard and outboard (1 each) and make fitment acc to variant.	30	
	3. Take HA lever (1 qty) and make fitment using screw runner and 3 screws. (IB 2 screws OB 1 screw - Side shield Attachment M4.2X1.41X9.6 SCREW, TAPPING, ROUND, WASHER (QTY - 3)) torque 2.5nm)	20	
	4.attach HA cap to the knob.	30	
	5. Take recliner knob (1qty) and make fitment with remote release lever.	38	
Plastic Part and Steaming	6. Check for OK quality and move it to next operation	20	239
	pallet rotation allowance	112	
	1.Steaming	107	
Craftmanship	2.Piping	238	238

Table 9. Cycle Time breakdown of proposed Child part Assembly, Plastic part assembly, Steaming and Craftmanship

4.11 Revised Cycle time as per stations:

Station Number	Station Name	Station Time in seconds	Station time in minutes	Manpower
1	Cushion Centre Trimming	152	2.5	1

2	Cushion Frame Assembly-1	240	4.0	1
3	Cushion Frame Assembly-2	232	3.9	1
4	Back Centre Trimming	238	4.0	1
5	Back Centre Trim + Frame Pre-assembly	232	3.9	1
6	Back Frame Assembly	230	3.8	1
7	Airbag Assembly-1	230	3.8	1
8	Airbag Assembly-2	206	3.4	1
9	Marriage	216	3.6	1
10	Wire Routing-1	220	3.7	1
11	Wire Routing-2	230	3.8	1
12	Child Parts Assembly	238	4.0	1
13	Plastic Parts Assembly	240	4.0	1
14	Plastic Part Assembly-2 +Steaming	239	4.0	1
15	Backrest steaming & craftsmanship	238	4.0	1
16	Headrest Fitment & Inspection	290	4.8	1
17	EOL Tester	280	4.7	1

Table 10. Revised Cycle Time of stations.

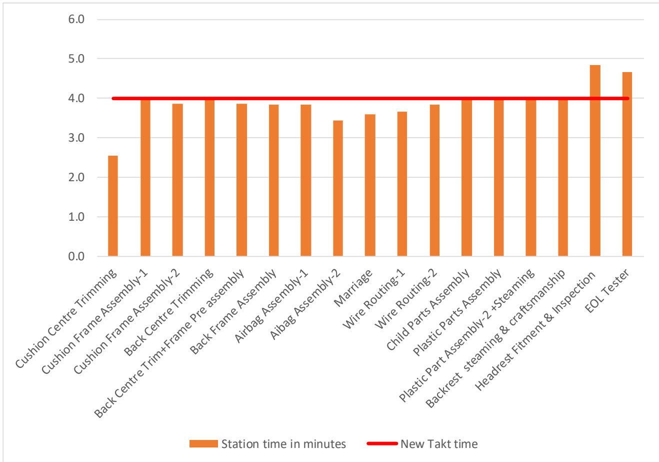

Fig 7. Relation between Station Cycle time Vs Takt Time with updated Line balance

4.12 Buffer Station Addition After Backrest steaming operation:

As changes in supply and demand can be compensated by extra station of buffer.

In manufacturing, the concept of buffering is defined as maintaining enough supplies to keep operations running smoothly. These supplies often include the raw materials needed for production, and the inventories of finished products waiting for shipment. Manufacturing facilities keep these buffer inventories on hand to help stabilize any fluctuations they experience with their supply and demand chains, production capacities and lead times. Without appropriate buffering, manufacturing processes would slow, expenses would increase, and profits would decrease.

4.13 Calculating Line Efficiency:

$$\text{Line Efficinecy} = \frac{Sum\ of\ all\ task\ times}{No.of\ workstations \times Takt\ time}$$

$$\text{Line Efficinecy} = \frac{65.9\ minutes}{18\ X\ 4\ minutes} x100$$

$$\textbf{Line Efficinecy} = \mathbf{91.75}\ \%$$

Proposed New Layout:

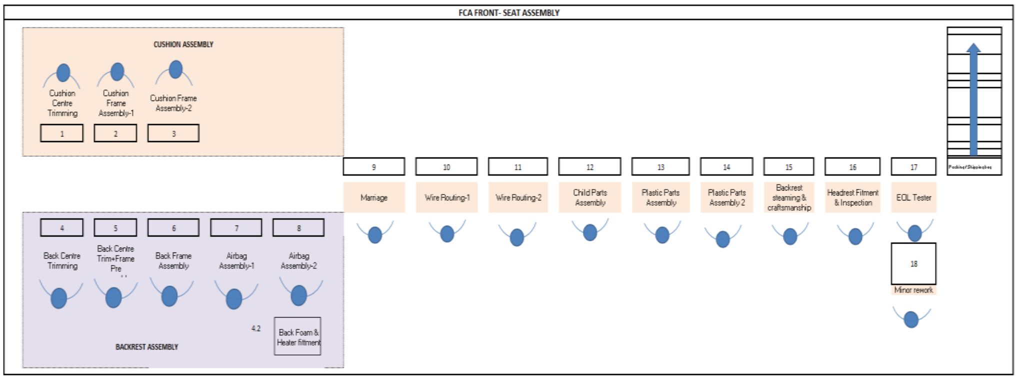

Fig 8. Proposed New Layout

5. Conclusion and Suggestions

5.1 Conclusions:

In the above example we could clearly understand that with proper arrangement and allocation of activities and tasks to individual workstations in assembly, we could increase Efficiency of line by 9 %. In the manufacturing industry it is always necessary to re-arrange the activities based on individual workstations so that the total processing time can be optimized and the effort – well balanced, leading to optimum level of production

1. Improved efficiency-9 % Increase in line efficiency.
2. Increased production rate-10 JPH to 15 JPH
3. Reduced Cycle time-6 minutes to 4 minutes
4. Minimum or Zero Ideal Time
5. Potential increase in profits and decrease in costs

5.2 Suggestions:

To ensure timely delivery of products to customers Lean Manufacturing Technique to be implemented.

1. **Skillsets /Training: -** As seat building is a majorly craftmanship of operators. Therefore, specific trainings on operations need to be given to operator for reducing the operation time.
2. **Time-and-motion study**, in the evaluation of industrial performance, analysis of the time spent in going through the different motions of a job or series of jobs. These studies came to be adopted on a wide scale as a means of improving the methods of work by subdividing the different operations of a job into measurable elements. Such analyses were, in turn, used as aids to standardization of work and in checking the efficiency of people and equipment and the mode of their combination.
3. **Maynard operation sequence technique (MOST)** is a predetermined motion time system that is used primarily in industrial settings to set the standard time in which a worker should perform a task. To calculate this, a task is broken down into individual motion elements, and each is assigned a numerical time value in units known as time measurement units, or TMUs, where 100,000 TMUs is equivalent to one hour. All the motion element times are then added together and any allowances are added, and the result is the standard time. It is more common in Asia whereas the original and more sophisticated Methods Time Measurement technique, better known as MTM, is a global standard
4. **Methods-Time Measurement (MTM)** is a predetermined motion time system that is used primarily in industrial settings to analyze the methods used to perform any manual operation or task and, as a product of that analysis, set the standard time in which a worker should complete that task.
5. **Robotic Integration**-For some specific operations Robotic can be integrated which can reduce further cycle time and increase accuracy.

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