Throughput Enhancement of Car Exhaust Fabrication Line by Applying MOST

E. A. H. Hanash\textsuperscript{1a}, A. N. M. Karim\textsuperscript{1b}, Saravanantanjong Tuan\textsuperscript{2}, A. K. M. Mohiuddin\textsuperscript{3}

\textsuperscript{1}Department of Manufacturing and Materials Engineering, \\
\textsuperscript{2}Department of Mechanical Engineering, \\
Faculty of Engineering, International Islamic University, Malaysia \\
P.O.Box 10, 50728 Kuala Lumpur, Malaysia \\
\textsuperscript{2}S Automotive Industry Sdn Bhd, Lot 9, Jalan Puchong, Shah Alam, Malaysia \\

E-Mail: \textsuperscript{1a}ebrahim.hanash@yahoo.com, \textsuperscript{1b}mustafizul@iium.edu.my, \\
\textsuperscript{2}saravanantt@toyota.com.my, \textsuperscript{3}mohiuddin@iium.edu.my

Abstract. In the fiercely competitive world market of today, manufacturers are facing increasingly tougher challenges and are compelled to find ways for productivity enhancement wherever possible in the whole supply chain. Nevertheless there are many facets in business process which can be explored for possible improvement, an immediate focus goes for the involved processes to re-engineer the activities in different workstations for an efficient and balanced assembly or fabrication line. In this paper an industrial case on fabrication line of a car exhaust system is presented to illustrate the scope of improvement by applying the MOST (Maynard’s Operation Sequence Technique) in streamlining the activities followed by assembly line balancing (ALB). The whole process of conducting various tasks is investigated to find out the lapses or wastes, to search for better option and to set the standard times for the tasks. Then individual workstation time is worked out by summing up the standard times of the involved tasks or activities and the concept of ALB is attempted to balance the fabrication line. So by possible reduction or elimination of the identified wastes or lapses workstation times including the bottleneck station are lowered. As a result the throughput of car exhaust systems is enhanced. According to the current practice, the Takt time is set at 3 minutes. However, upon an analysis through use of the MOST, the bottleneck station time is found to be as low as 1.27 minutes. Thus an opportunity of meeting the current level of demand with significantly lower workforce (with 2 operators instead of 5) is revealed. Alternatively, if necessary, an increased workload can be assigned for the current level of workforce. Moreover, with proper distribution of activities among the workstations using the concept of ALB, the line efficiency is found to be improved. So the line balance loss in the current setup of production line is also possible to be largely reduced. Thus daily production of car exhaust, if modified with suggested changes with the current workforce, could be more than double compared to the current daily output. Hence, effectiveness of the MOST followed by ALB applications to expose and remove the operational wastes in the work flow is reiterated with enhanced throughput.

1. Introduction
Fierce competition among business operators in the current world market is due to the change of customer behaviour towards product features and advancement in technology which has led to manifold challenges to the manufacturers [1]. Customers value different products that have comparable features with high quality but lower cost [2, 3]. Companies, therefore, start to introduce
new products with different features and reasonable price. However, to sustain under such conditions, manufacturers have to adopt a low cost and/or a differentiation strategy to find ways to increase the throughput and overall productivity of the organization [4]. Thus they find ways to increase the output for enhancing the profitability and maintaining competitive edge [5].

There are many different methods to increase and enhance the productivity, for example, Value Stream Mapping (VSM), Just in Time (JIT), 5’s, Lean Manufacturing, Workplace Organization, Work Measurement, and Assembly Line Balancing [6, 7]. Productivity improvement refers to the increase in output per work-hour or time expended. Among the methods for increasing the productivity is the use of predetermined time study (PTS) under the work measurement category. This method is similar to other lean manufacturing methods in removing non-value added activities from the process [8, 9]. An operator can be seen busy in the workplace but when measuring the standard time for certain activity, the wasted time in non-added value activity might be significant.

The predetermined study not only used in setting the standard time in manufacturing sector but it has been applied in the agriculture sector [10]. MTM is found to be more applicable than other methods, except for mental works. Hence, by realizing the significance, a number of researchers have engaged themselves to further the methods and ended up with different techniques. These are predetermined motion time system (PMTS) methods, time estimating methods etc. Moreover, on the basis of data type, motion variations and time unit, several PMTS methods such as Methods Time Measurement (MTM), Work factor, Maynard Operation Sequence Technique (MOST) and Modular Arrangement of Predetermined Time Standard (MODAPTS) are reported in literature [11-14]. The MOST is very popular in setting the standard time of an operation by dividing the process into small elements and calculating the time in Time Measurement Unit (TMU). This method has been widely used by many researchers due to its good accuracy and ease in implementation [14-16]. The MOST system is used to calculate the cycle time for an operation based on Pre-determined time study data.

A typical MOST work sequence code would look like this: an example [17]: The operational element is described as ‘Apply pressure and push the chassis trolley about 5-7 steps to the body side panel bonding bay’. There are general and controlled moves and the index values are assigned as follows:

A1 B0 G3 A16 B0 P6 M16 X0 I0

Step 1: Add up all the subscript numbers. Thus, 1 + 0 + 3 + 16 + 0 + 6 + 16 + 0 + 0 = 42 (the subscript is the MOST index value)

Step 2: Multiply the sum of the index by 10. This answer is 42 x 10 = 420 TMU

Step 3: Thus, the time in TMU is converted as 420 TMU * 0.036 seconds = 15.12 seconds

The case as presented in this paper is based on a study conducted in a local auto company to explore the scope of possible improvement in productivity of a car exhaust fabrication line for which excessive time is consumed with the existing level of workforce. Standardization of the task times and revision of work methods have been made to show excess capacity. To do so, the MOST is adopted to set the standard times and to eliminate or reduce the non-value added activities (NVA) and to detect the bottlenecks correctly. The whole assembly line currently consists of five workstations, each is supported by an operator and equipped with necessary facilities.

2. Predetermined Motion Time System

Predetermined motion time studies (PMTS) is one of the work measurement methods which can be applied to set the standard time of the process. PTMS such as methods time measurement (MTM), MOST, and WORK FACTOR, have primarily been used for predicting and quantifying the time it should take to assemble a product [18]. The PMTS methods used to determine the standard time that can be taken to perform certain process. It can be used to divide large tasks into small elements in order to balance the work between workers and make the flow more efficient. Therefore, as recommended by [19] all workstation activities or items have to be organized in an efficient manner.

The PMTS application steps are as follows [20]:

2
Synthesize the method that would be used by a worker to perform the task. The method should be described in terms of the basic motions involved in the task based on a predefined workplace layouts and set of tools.

Retrieve the normal time value for each motion element, based on the work variables and conditions under which the work element is performed. Sum the normal times for all motion elements to determine the normal time for the task.

Evaluate the method to make improvements by eliminating motions, reducing distances, introducing special tools, introducing simultaneous right and left hand motions and so on.

However, having the variation in level and scope of applications some common PMTS methods which are repeatedly referred in literature [11] for solving the intricate operational issues of automotive industries are described.

2.1 Maynard Operation Sequence Technique (MOST)

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 [21]. It is a powerful analytical tool that helps increase productivity, improve methods, facilitate planning, establish workloads, estimate labor costs, improve safety and maximize resources [22]. It uses as same time units as MTM; TMU developed around 1967 under the direction of Kjell Zandin [23]. It has been introduced by H. B. Maynard and Company, Inc. in the United States in the year of 1960 [24]. Though industrial application of MOST started from 1967 in the form of Basic MOST, the Basic MOST was reformulated in 1970 and renamed as Clerical MOST for performing the administrative and the clerical work of the production and service industries.

MOST focuses on the movement of an object, as a result it was identified that there are repetitive movement pattern such as, reach, grasp, move, position the object etc. To compute the standard time by using MOST, a task is broken down into individual motion elements. After that, numerical time value in units known as time measurement units (TMUs) is assigned to each of the individual motion element.

In general, there are only two ways by which the object can be transferred and moved, either they are picked and moved freely through space, or they are moved while maintaining contact with another surface. There are three types of MOST, which are Basic MOST (for the activities between 20 s to 2 min.), Mini Most (for the activities shorter than 20 s) and Maxi Most (for the activities above 2 min.) as stated by Jamil et al. [21]. The literatures revealed that, MOST has superior characteristics over other time study methods. Some important advantages of MOST are in terms of its fastness compared to other work measurement techniques, scope of calculating the time in advance, easiness in learning, universal application and economy.

In this project Basic MOST is used for determining the standard time and improving processes and productivity enhancements.

2.2.1 Basic MOST

Basic MOST system, compared to other PMTS systems, concentrates on the movement of ‘objects’ rather than the basic motions of ‘worker’[13]. This criterion made Basic MOST more accurate, fast, economical and simple to implement compared to other PMTS systems. It is found that, Basic MOST is more accurate than the conventional time study method in determining the relevant true time [25]. It consists of sequence models representing two basic activities to measure work which are General Move, Controlled Move AND Tool Use. Table 1 illustrates the different types of moves.
Table 1: Types of Basic Moves in Basic MOST

| Activity       | Sequence Model | Sub-activities |
|----------------|----------------|----------------|
| General Move   | ABG ABP A      | A – Action Distances  
                  |                | B – Body Motion                  |
|                |                | G – Gain control                  |
|                |                | P – place                          |
| Controlled Move| ABG MXI A      | M – Move Control                    |
|                |                | X – Process Time                    |
|                |                | I – Align                          |
| Tool Use       | ABG ABP * ABPA | F – fasten                           |
|                |                | L – Loosen                           |
|                |                | C – Cut                             |
|                |                | S – Surface treat                    |
|                |                | R – Record                           |
|                |                | M – Measure                          |

The time unit used in calculating and analyzing the work activities by using MOST is TMU where 1 TMU is equal to 0.036 second, or 0.0006 minute or 0.00001 hour.

2.2.1.1 Basic MOST Calculation

There is a sequence of steps to be followed in filling the calculation sheet of the Basic MOST method in order to set the standard time. These steps include:

1. Indicate at the top of the form: Area of work, Operation name, Department, Analyzed by.
2. Document the method to be analyzed by dividing it into a number of successive steps corresponding to the “natural” breakdown of the activity. Number each step in chronological order.
3. Select an appropriate sequence model for each method step.
4. Determine the type of move for that certain small element.
5. Indicate the correct index value for each parameter within each sequence model.
6. Add parameter index value together, multiply by 10 and insert the result in right hand column to arrive at the time for the sequence model in TMU.
7. For the total activity time in TMU, add all sequence times together and insert the result in the bottom right-hand corner. If desired, these time values may be converted to hours, minutes, or seconds in the bottom left-hand corner of the sheet.

As illustrated in Table 2, the time-estimation procedure by the MOST, a task ‘Welding the flanges to CKD (complete knock-down) pipe’ is chosen from the operation at W/S – 1 of the undertaken assembly line as an example.

Table 2: Four task elements for ‘welding the flanges to CKD pipe’, sequence models and index values

| SN   | Description of task element | Sequence Model | Index value |
|------|----------------------------|----------------|-------------|
| 1    | Pick up flanges and clamp on jig. | General Move   | A3 B6 G3 A0 B0 P3 A3 |
| 2    | Pick up CKD pipe and clamp on jig. | General Move   | A3 B6 G3 A0 B0 P1 A0 |
| 3    | Pick up bracket and clamp on jig. | General Move   | A3 B6 G3 A0 B0 P0 A0 |
| 4    | Take up welder and mask, tack weld flanges (3 point). | Tool Use   | A6 B6 G3 A0 B3 P3 A0B0P0 A0 |
In Fig. 1, 2, and 3 the index value tables for each of the three types of moves are presented.

### General Move

| ABG | A | B | G | P | Index x 10 |
|-----|---|---|---|---|-------------|
|    | Action Distance | Body Motion | Gain Control | Placement |             |
| 0  | ≤ 2 in. (5 cm.) | Sit or Stand | Pickup Tool | Light Object | 0           |
| 1  | Within Reach    | Sit or Stand | Light Object | Light Object Sine | 1           |
| 3  | 1 - 2 Steps     | Sit or Stand | Loose Fit Blind or Obstructed | Light Pressure | 3           |
| 6  | 3 - 4 Steps     | Sit or Stand | Heavy Pressure | Heavy | 6           |
| 10 | 5 - 7 Steps     | Sit or Stand | Heavy Pressure | Blind or Obstructed | 10          |
| 16 | 8 - 10 Steps    | Sit or Stand | Heavy Pressure | Intermediate Moves | 16          |

**Figure 1: Index values for the General Move in Basic MOST**

### Controlled Move

| M | Move Controlled | X | Process Time | I | Alignment |
|---|-----------------|---|--------------|---|-----------|
| 1 | ≤ 12 in. (30 cm.) | Crank | 5 sec. | 01 Min. | .0001 Hr. | 1 Point |
| 3 | >12 in. (30 cm.) | Resistance | 1 Rev. | 1.5 sec. | .02 Min. | .0004 Hr. | 2 Points ≤ 4 in. (10 cm.) |
| 6 | 2 Stages /4 in. (60 cm.) | Total | 2 - 3 Revs. | 2.5 sec. | .04 Min. | .0007 Hr. | 2 Points > 4 in. (10 cm.) |
| 10| 3 - 4 Stages | Total | 4 - 6 Revs. | 4.5 sec. | .07 Min. | .0012 Hr. |
| 16| 6 - 9 Steps | Total | 7 - 11 Revs. | 7.0 sec. | .11 Min. | .0019 Hr. |

**Figure 2: Index values for the Controlled Move in Basic MOST**
3. Methodology

As mentioned earlier the purpose of the study is primarily to set the standard time for the operations and to find ways for improvement of the whole process by minimizing the waste and/or automate some parts of operations. The Basic MOST has been applied for standard time and Assembly Line Balancing (ALB) is used for balancing the production line by making the local cycle time of all workstations equal or closer to the Takt time.

Basic MOST follows certain procedures by starting to identify the main tasks in the fabrication line. After that, the tasks are divided into small elements. Video recorder is also needed to capture the process, how workers do the job and how the operators move when doing the task. The next step is to study all the movements of a task element and to define them whether in terms of general move, controlled move or a tool use. Then index values are assigned to each move. The sub-numbers of the moves are then added and multiplied by 10 to find the time in TMU to be taken by the operator. To get the time in seconds, the TMU number is multiplied by 0.036. Therefore, by adding all the times of the elements to get the time in each workstation. If the time in a workstation is not equal compared to other workstations then ALB is adopted to rearrange the activities in all workstation to make the cycle time close to the Takt time. The following formulas are used:

\[
\text{Takt time} = \frac{\text{total work time available}}{\text{Units required}} \quad (1)
\]

\[
\text{Workers required} = \frac{\text{Total operation time required}}{\text{Takt time}} \quad (2)
\]

\[
\text{Efficiency} = \frac{\text{Total operation time}}{(\text{actual number of workstations}) \times (\text{cycle time})} \quad (3)
\]

\[
\text{Line balance rate (LBR)} = \frac{\text{Total net time of all processes}}{(\text{longest process time})(\text{number of workers})} \times (100\%) \quad (4)
\]

\[
\text{Line balance loss rate (LBLR)} = 100\% - \text{LBR} \quad (5)
\]

\[
\text{Cycle Time} = \frac{\text{production time available per day}}{\text{units required per day}} \quad (6)
\]

4. Case Study

As stated earlier this study is conducted in a local company in Malaysia within a supply chain of automotive parts manufacturers. The assembly line engaged in producing car exhaust system in the company is painstakingly investigated. The aim is to set the standard time and also to improve the productivity and performance of the fabrication line. As indicated in Figure 4, there have been five workstations in the assembly line and all the manual tasks are currently done by five workers or
operators. A general overview of the assembly line and the procedure in evaluating the standard times has been presented in the following sections:

![Current layout plan](image)

**Figure 4: Current layout plan**

**4.1 Overview of the Undertaken Assembly Line**

Five workstations engaged in performing five major operations are:

1. Workstation - 1 (W/S-1): Flanges, CKD pipe and Bracket tack weld,
2. Workstation - 2 (W/S-2): CKD pipe, Chamber and Hanger tack weld,
3. Workstation - 3 (W/S-3): Flanges, Chamber set and Hanger tack weld,
4. Workstation - 4 (W/S-4): Complete Welding of Chamber, Pipe and Hanger Bracket and
5. Workstation - 5 (W/S-5): Leaking Test.

All activities in the workstations are shown in the layout plan in Figure 4 for the whole assembly of car exhaust system. A proper layout plan is meant to improve the line efficiency by arranging the equipment or distributing the workloads according to its function. The whole production line should ideally be designed to eliminate waste in material flows, inventory handling and management. Summary of time for the current operations for car exhaust assembly is presented in Table 3.
Summary of the five workstations’ operation times are presented in Table 4. The Table includes the time in time measurement unit (TMUs), seconds and in minutes. An allowance is 12% as decided by the management is included. This allowance is given to the employees for their personal needs, fatigue, etc.

4.2 Process Chart

A process chart is prepared to illustrate the task elements performed in a workstation. A brief description of the elemental process, distance to be covered and the time required in performing the elemental tasks are recorded and presented in a tabular form. Table 4 shows the Process chart for workstation, W/S -1 as per earlier procedure.

| No | Operation Name | Code | On-line TMU | On-line Seconds | With 12% allowance Seconds | With 12% allowance Minute | Remark |
|----|----------------|------|-------------|-----------------|---------------------------|--------------------------|--------|
| 1  | W/S 1          | M    | 1638.9      | 59.0            | 66.1                      | 1.10                     | "M" in column 'code' represent manual assy' |
| 2  | W/S 2          | M    | 1555.6      | 56.0            | 62.7                      | 1.05                     |
| 3  | W/S 3          | M    | 1388.9      | 50.0            | 56.0                      | 0.93                     |
| 4  | W/S 4          | M    | 1888.9      | 68.0            | 67.2                      | 1.27                     |
| 5  | W/S 5          | M    | 805.6       | 29.0            | 32.5                      | 0.54                     |
|    | Total          |      | 7277.8      | 262             | 293.4                     | 4.90                     |

Value added time = Operation time/Total time = (59.00/78.92)= 74.78% (excluding Offline Job)
4.3 Takt Time of Car Exhaust Assembly (Present Situation)

Takt time is calculated by dividing the available working time in a day with the daily customer demand for the items. Thus this parameter determines the required ability of a production line to meet the customer orders. To satisfy the demand, the bottleneck station cycle time in the line should not exceed the Takt time. Otherwise it would not be possible to meet the set target of customer order. Thus by evaluating detecting the required production output, necessary resources may be mobilized. The Takt time calculation procedure is shown in Table 5.

Table 5: Takt Time calculation

| Total working time | 9.0 hours |
|--------------------|-----------|
| Total fabrication time | 4 minutes |
| Fixed loss | 1.5 hours |
| Longest Workstation time | 1.27 minutes |
| Actual working time | 8.0 hours |
| Required quantity per day | 160 pieces |

The formula (1) is used for computing the Takt time is given in following computation:

\[
\text{Actual Working Time} \times \frac{8 \text{ hrs}}{160 \text{ units}} = 0.05 \frac{\text{hrs}}{\text{pcs}} = 3 \frac{\text{min}}{\text{pcs}}
\]

(1)

Takt time represents the ability of the production line to satisfy the demand of the customers. If any workstation time is longer than the Takt time, then it is indication that the production line is not able to satisfy the customer order. On the other hand if each workstation time is less than the Takt time, then this implies that the production line can satisfy the order. However, in this situation the production line is not fully utilized.

By analyzing the current situation for the exhaust production line, it is found that there is no problem in satisfying the customer demand. The Takt time is 4.3 minutes and the workstation time is much less than the takt time. Thus with the current setup, the car exhaust production line has over capacity and operators are to remain idle for considerable time.

4.4 Analysis of current fabrication line capability

The current setup of fabrication line has enough capability to meet the customer daily demand of 160 units. The Takt time in this case is 3 min and the workstations processing times is far less than the Takt time. The longest operation time as observed in workstation 4 (bottleneck) is only 1.27 minutes which should be considered as the cycle time for the line.

Under this situation, the operators are not to be adequately busy and as a result they may be engaged for some other additional activities or a few of them may be laid off.

5. Proposed Modification

Since there is an excess capacity of the fabrication line with the current situation, meeting the demand does not appear to be an issue for the management. However, there should be initiatives for continual improvement to secure competitive advantage. In this respect some improvement strategies are proposed to enhance the performance of the line as well as to improve resource utilization for the company.

When the Takt time is shorter than the bottleneck operation time (cycle time), the assembly line has to be improved by introducing more efficient methods or incorporating additional resources only. Otherwise production target based on customer demand is not possible to be met. But for a situation when takt time is longer than the bottleneck cycle time of the line as prevailing in the car exhaust fabrication line, is a sign of lower productivity of the system. To avoid such situation actions need to be taken either to divert some operators to other activities or lay off them. Alternatively production target should be increased to meet additional demand to be created through proper marketing for the product or product family so that the existing resources can be utilized properly.
5.1 Reducing number of workers maintaining current demand level

Under the current situation there is an excess of workers as can be seen in Figure 5. The assembly line requires less number of operators to assemble for meeting the current demand. In fact, excess workers means extra cost for the company in the form of salaries, wages, bonuses and other privileges to be paid to workers. This cost for the idle time of the operators is a waste. It is necessary to prevent this waste so that the company can benefit from the money they spend and become competitive and sustainable. One of the options to decrease the cost and increase the productivity for the assembly line as well as for the whole company is to reduce the number of operators from the car exhaust production line either by rotating them into other jobs or laying them off.

Minimization of the number of workers in the production line by engaging them in any other works can be another option. By this arrangement a company can benefit and increase its productivity. However, first it is necessary to determine the number of workers ideally required for the production line. This evaluation is to be followed for other departments also so that a holistic picture becomes evident for the company in the context of manpower requirement. Thus in case there is lack or shortage of manpower in any department they can make use of the excess workers found in other departments. For the car exhaust assembly line, the calculation procedure of manpower requirement is given below.

We know from Eq. (1), the Takt time = \( \frac{\text{Total work time available}}{\text{Units required}} = \frac{478 \text{ min}}{160} = 3 \text{ min} \)

The required number of operators can be found from Eq. (2),

Workers required = \( \frac{\text{Total operation time required}}{\text{Takt time}} = \frac{4.9 \text{ min}}{3 \text{ min}} = 1.63 = 2 \text{ workers.} \)

The efficiency of the current situation of the production line can be assessed by using Eq. (3):

Efficiency = \( \frac{\text{Actual operation time}}{(\text{actual number of workstations}) \times (\text{cycle time})} = \frac{4.9 \text{ min}}{(5) \times (1.27)} = 77 \% \)

The second option to decrease the number of workers in the car exhaust assembly line is by laying off the excess workers. This option is not usually desirable by the management because of the negative consequences and the cost associated with the firing off labors. Compensation is to be given to the workers laid off while his/her contract not finished yet. Therefore it is often a better option to create opportunities for them to work in another department or production line. This approach appears to be more appropriate for a company to be more conducive and productive.

After properly assessing the required number of workers, the management can decide how many workers to engage in other logistic or production works or to lay off. However, this decision depends on the necessity for the excess workers. In this case the management can make use of 3 workers from the production line and engage them in other works. This proposed solution can help the manufacturer
to increase the overall productivity of the company as the 3 excess workers are to work in other best suited operations so that they can be more productive.

For the car exhaust assembly line, number of workers is minimized and workstations are reduced to two from five by merging the first two operations into one and the remaining three operations into another. Thus for the changed situation, number of workstations is reduced to two for which two operators are to be engaged. So with the new arrangement the efficiency of the production line would increase from 77% to 89% as computed by eq. (4).

\[
\text{Efficiency} = \frac{\text{Total operation time}}{(\text{actual number of workstations}) \times \text{(cycle time)}} = \frac{4.9 \text{ min}}{(2) \times (2.74)} = 89.4 \%
\]

The changed production line arrangement is depicted in Figure 6 where some of the workstations combined together to be run by only 2 workers instead of 5 workers.

![Figure 6: Scenario of car assembly line with two operators in combined activities of workstations](image)

5.1.2 Utilizing excess capacity for increased production

The second solution for the current situation would be to increase production either by adding a similar product along or increasing production of the current car exhaust system. Thus the number of units produced per day can be increased and hence lower the Takt time. When the Takt time is lowered and becomes close to the cycle time this will increase the productivity of the assembly line. As the number of units to be produced increases, the Takt time is to be low until it reaches the optimal level when the Takt time equals to the cycle time. Let us assume a case for doubling the number of units produced i.e. 300 units / day and see the improvement in the production line.

\[
\text{Takt time} = \frac{\text{Total work time available}}{\text{units required}} = \frac{478 \text{ min}}{300 \text{ units}} = 1.60 \text{ minutes}
\]

This is to minimize the idle time and increase the efficiency of the assembly line. However, the optimal demand that will make the production line 100% efficient and minimize waste time to zero level. This demand can be found by setting the Takt time equals to the cycle time and this demand is to be 376 units with the takt of 1.30 minutes as shown below.

\[
\text{Takt time} = \frac{\text{Total work time available}}{\text{units required}} = \frac{478 \text{ min}}{376 \text{ units}} = 1.30 \text{ minute}
\]

However, reduction of Takt time may be possible by facilitating the processes in the workstations with improved methods, tools and equipment.
6. Conclusion

In this endeavor, methods such as MOST and ALB have been used for improving productivity of the assembly line dedicated for production of car exhaust system. The project is initiated to study whole assembly line operations and to identify if there is any scope of operational improvement. Some interesting observations were made with the Takt time being considerably longer than the bottleneck station cycle time. This provided an indication of excess capacity of the assembly line. However, this critical observation would not have been revealed without the investigation. The fact that the line is underutilized with the existence of considerable amount of idle time of the operators opens up an opportunity for revamping the whole production system to improve efficiency. Activities or tasks involved in each of the five workstations were divided into elemental tasks and subsequently their standard times were set by using the MOST. The huge gap between the Takt time and the bottleneck station cycle time is observed which has driven us to search for alternative action plan. It has been found that the same output of 160 set of car exhaust system is possible to be achieved by engaging even less than half of the manpower currently involved. Five workers involved now in five workstations. However, with suggested modification in the assembly line by rearranging the workstations and distribution of activities it would be possible to achieve the same target of production by engaging only two operators. So effectiveness of the MOST and ALB application can be recognized by setting the standard times for the activities as well as balancing of the workstations times of an assembly. A manufacturing company can enhance their resource utilization and achieve operational sustainability by becoming more economic and competitive.

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