Increase Productivity with Lean Concept in Final Visual Inspection Process of Hard Disk’s Suspension

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Abstract—The research arranged as a model for the improvement of production processes in the electronics factory purposed to increase the productivity of final visual inspection process of suspension products when its productivity was lower than expected. According to the study, it found that the problem is caused by the inefficiency of the process resulting waste of final visual inspection process. For the improvement by using Lean concept in order to eliminate waste which leads to non-value processes, the improvement became successful as anticipated, resulting in the continuity of the process flow. The result presents that the efficiency of suspension increases, which means the productivity of the process increasing 16.23% and Lot Accept Rate (LAR) increasing 1.52%. Moreover, it affects to the reduction of Defect Parts Per Million (DPPM) for 97.0%. After the improvement, the method was extended to the other zones and it was found that the productivity of final visual inspection process increases from 2,895 pcs/hr to 3,257 pcs/hr or 13.13%, resulting in the cost reduction for the manufacture.

Keywords—lean concept, visual inspection, productivity.

I. INTRODUCTION

CASE Study from the factory 18 processes from the high volume manufacturer which continuously produces Hard Disk’s Suspension shows the productivity of final visual inspection process lower than expected target 3,200 pcs/hr.

From 14 production lines, the operators inspect all parts by microscope and classify to acceptable or unacceptable. The average of inspection productivity is 2,895 pcs/hr. However, 6 from 14 production lines B, C, G, J, K and N shows lower inspection productivity than average. These lines were selected for processing improvement.

Fig. 2 The productivity final visual inspection process before improvement

Criteria for final visual inspection process:
1) Productivity of final visual inspection process in term of pcs/hr.
2) To verify the part quality in term of percentage Lot Accept Rate (LAR) to qualify parts before sending to customers by internal QC Sampling process, acceptable or unacceptable.
3) To verify the part quality in term Defect Part Per Million (DPPM) by customer sampling check process, acceptable or unacceptable.

II. OBJECTIVE AND SCOPE

A. Review Stage
To apply Lean concept for Final Visual Inspection Process of Hard Disk’s Suspension that increase inspection productivity at manufacturing area.

B. Scope
To study and improve the final visual inspection process of 6 selected production lines B, C, G, J, K and N.
III. METHODOLOGY

Because the productivity of final visual inspection process is lower than expected target, Lean concept should be applied for production line improvement, elimination non-value process, increasing value process that make continuous flow of process.

- Study work procedure, time measurement and flow process chart
- Improve all procedures to be properly
- Balance workload and specify area of inspection
- Create inspection method by using microscope
- Re-layout

Fig. 3 Flow of improvement process

A. Study work procedure, time measurement and flow process chart

The primary process of the improvement was to record the present data of working processes in order to acknowledge every worker’s operation which would be applied for sequence time measurement. The received information would be draw in Yamazumi chart to show the workload of every operator, including flow process chart in order to know which activity causes value and which one causes non-value.

B. Improve all procedures to be properly

The processes are as followed:
- Cancellation of the writing of NG tag.
  The writing of NG parts tag of every inspection operator leded to waste which is not related to the visual inspection; therefore, setting position of NG parts standard instead of writing NG parts tag is able to reduce equipment and paper usages including writing time for 7.54 sec
- Cancellation of the reworking NG parts.
  For the reworking NG parts of every inspection operator, they must transfer products to another operator and it led to waste because of repetition; therefore, only one operator would be appointed to rework NG parts. This method is able to reduce time for 8.73 sec
- Change of equipment for separate NG parts.
  To separate OK parts and NG parts from each other is important to the final visual inspection process because only OK parts will be delivered to the customer. Before the improvement, it found that the use of Tweezers to separate NG parts requires 5.02 sec. However, after improvement by Air Vacuum, the process requires only 3.84 sec. Thus, the change of equipment for separate NG parts can enhance facility and help reduce time for 1.18 sec.

<table>
<thead>
<tr>
<th>Index</th>
<th>Activity</th>
<th>Before</th>
<th>After</th>
<th>Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pick Tray up</td>
<td>2.89</td>
<td>2.89</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Flip Tray</td>
<td>5.04</td>
<td>5.04</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Visual Inspection Parts - Back Side</td>
<td>33.96</td>
<td>33.96</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Separate NG parts</td>
<td>5.02</td>
<td>3.84</td>
<td>1.18</td>
</tr>
<tr>
<td>5</td>
<td>Rework NG parts</td>
<td>8.73</td>
<td>0</td>
<td>8.73</td>
</tr>
<tr>
<td>6</td>
<td>Writing of NG tag</td>
<td>7.54</td>
<td>0</td>
<td>7.54</td>
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<tr>
<td>7</td>
<td>Flip Tray</td>
<td>5.04</td>
<td>5.04</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>Put Tray down</td>
<td>3.11</td>
<td>3.11</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>71.33</td>
<td>53.88</td>
<td>17.45</td>
</tr>
</tbody>
</table>

C. Balance workload and specify area of inspection

After suitably improving of working process, regarding Fig. 5, it found that the workload of each operator was not constant. Some required over Takt time (T.T.) which has been set at 1.125 sec/pcs or 67.5 sec/Tray and some required lower Takt time.

![Yamazumi Chart](image-url)

Fig. 5 Yamazumi Chart before improvement

The problem was the unsuitable numbers of operator and zone of Suspension as in Fig. 6. In other words, some operator gained large zone contrasting to the others. The improvement reset the inspection zone by distributing equally. The distribution was calculated from the duration of inspection. The inspection process can be divided into 6 zones, having 2 operators per zone so that the piece flows smoothly and they gain equal workload.
The new inspection zone distribution for equal workload and work duration among the operators added more inspection procedures due to the time balance as in Fig. 9. The cancellation of double duties intended to reduce waste from inspection, resulting in time duration under Takt time.

D. Create inspection method by using microscope

After reset the inspection zone, it also found that there was no standard measurement for under microscope inspection. Hence, the techniques of under microscope inspection have been specified by separating pictures into focus so that the picture will not be too large and the brain can remember the picture easier. With this solution, the process of inspection became faster.

Fig. 8 Create inspection method zone 3

For the inspection under microscope, as in Fig. 8, the picture will be separated into zone and each zone will be divided into focus so that the operators will inspect easier and can identify the direction to prevent confusion during the process.

E. Re-layout

After zone adjustment of inspection operators, they gain equal workloads and convenient procedure; there is still a problem that is the difficulty of piece flow due to the table layouts were far from each other, causing waste from transportation. Another problem is operators have to flip tray for inspection parts back side 1 time and flip tray for sending 1 time. There are 6 inspection operators so the total flip tray is 12 times. This also causes waste from process. Consequently, to eliminate waste, the layout final visual inspection process must be re-layout to be more closely and the inspection will be divided into 2 groups according to the zones.

Fig. 9 Layout final visual inspection process after improvement

The result of re-layout as in Fig. 9 is the work flows more smoothly. Each operator can send the piece to another operator by themselves. No more transportation operator and they can inspect the part instead, resulting in no confusion, reduction of standard work in process and reduction flip tray times from 12 to 4. Due to the fact that they can send the piece without flip tray again, operators gain more time for their job.

IV. Result

The improvement indicator is divided into productivity and inspection quality as followed:

Fig. 10 Productivity by line before and after improvement

Fig. 11 LAR by line before and after improvement
Before the improvement, there was high variance in each line which was lower than expected target which has been set as in Fig.10, 11 and 12. After the improvement, it found that the inspection productivity and acceptance becomes higher and reach to the expected target. Besides, the variance in each line becomes lower and the results are more similar.

V. CONCLUSION

Regarding the improvement of final visual inspection process of suspension products for 6 lines which consist of B, C, G, J, K and N, the application Lean concept to eliminate waste leads to the continuous flow of manufacturing processes which can be concluded into percentage indicators as follows:

According to the improvement result, it comes to the conclusion that the productivity of final visual inspection processes increases for 15.58%, LAR for 1.52% and DPPM decrease for 97.00%. This result reached the expected target. After the final visual inspection processes improvement of 6 lines, the method was applied with the other 8 lines so the total number is 14 lines.

In respect of the above improvement, the productivity of final visual inspection processes of 14 lines is 3,257 pcs/hr which is higher than 3,200 pcs/hr of standard measurement, resulting in the increase of inspection productivity at 57 pcs/hr or 1,037 pcs/day or 32,199 pcs/month and the revenue rising per 1 line amounting THB 750,244/month. For the total revenue of 14 lines, it amounts THB 10,503,411/month. The outcome from Lean concept to increase the productivity of final visual inspection processes by elimination of waste for the continuity of process flow. In addition, from Fig. 16, it results to the higher overall productivity all process of suspension manufacturing after the improvement as well.

REFERENCES


