Estimating The Cycle Time And Cycle Time Reduction Across The Assembly Line Production

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***Abstract*- This thesis project examines cycle time reduction. The project shows that these reduction efforts cannot be addressed in isolation. Instead, they represent the outcome that results from improving the fundamental manufacturing processes across the supply chain.**

I. INTRODUCTION

The cycle time (flow time, or manufacturing lead time) of a job is the time required for the job to go through the factory. Shortening the job cycle time is very important for a factory, at least for the following reasons:

(1) Each job represents an opportunity cost for the factory. A long cycle time means it is difficult to convert the opportunity cost into profits in the short term.

(2) Long job cycle times result in the accumulation of work-in-progress (WIP), which makes the shop floor management a challenging task.

(3) In a manufacturing factory, the risk that a wafer is contaminated increases if the cycle time is long.

These issues are related with cycle time, cost, and yield (i.e., product quality). In fact, the three factors are not only the keys to the competitiveness of a manufacturer [1–3], but also decisive factors for the sustainability of the manufacturer. In the past, support from the government enabled the continued growth of manufacturers in some regions, such as india and South Korea. After such support disappears, how to continue to maintain competitiveness and sustainability becomes a big problem. For example, not being able to push costs down further has forced many bearing (DRAM) manufacturers to exit the market. The survived continue to reduce the job cycle time, so as to respond more quickly to changes in customer demand, and thus gain a competitive advantage [4]. A shorter job cycle time also means it is possible to commit an attractive due date to the customer. That helps to expand the market share and to ensure sustainability.

II. CYCLE TIME STUDY

The time it takes to do one repetition of any particular task typically measured from "Start to Start" the starting point of one product's processing in a specified machine or operation until the start of another similar product's processing in the same machine or process.

Cycle time is commonly categorized into:

1) Manual Cycle Time: The time loading, unloading, flipping/turning parts, adding components to parts while still in the same machine/process.

2) Machine Cycle Time: The processing time of the machine working on a part.

3) Auto Cycle Time: The time a machine runs un-aided (automatically) without manual intervention.

4) Overall Cycle Time: The complete time it takes to produce a single unit. This term is generally used when speaking of a single machine or process.

5) Total Cycle Time: This includes all machines, processes, and classes of cycle time through which a product must pass to become a finished product.

This is not Lead Time, but it does help in determining it.

What Is Cycle Time Loss

Whenever equipment runs slower than its maximum operating speed (slower than its Ideal Cycle Time) it incurs cycle time loss. Cycle time loss is typically broken into two categories:

- Slow Cycles
- Small Stops

Slow cycles occur when equipment runs slower than its maximum operating speed– but is running. For example, an operator may deliberately run equipment slow to manage material quality issues.

Small stops occur when equipment has stopped – but for a short enough period of time that the stop is more or less still considered to be part of a cycle (in other words it is not considered to be a down time event). An operator typically addresses small stops without the involvement of maintenance personnel. For example, an operator may clear repeated equipment jams caused by material feed issues.

Defining Cycle Time Loss

When considering the production states of Run, Unplanned Stop, Planned Stop, and Not Scheduled, cycle time loss falls squarely in the Run state (it measures losses that occur while the process is running). However, it does not measure all losses that occur while the process is running. Quality losses are a completely independent category of loss.

A precondition for measuring cycle time loss is to know the Ideal Cycle Time of the process. Ideal Cycle Time is the theoretical minimum time to produce one piece (which may be different for different parts). Ideal Cycle Time is basically the same as maximum operating speed. Mathematically, the two are reciprocals of each other: Ideal Cycle Time is measured as time per part (e.g., one second per part) while maximum operating speed is measured as parts per time (e.g., one part per second; more commonly referred to as 3,600 parts per hour).

There are two common approaches to determining the Ideal Cycle Time:

- Nameplate Capacity: This is the maximum operating speed that the equipment builder specifies (e.g., you may buy a press with a design capacity of 120 strokes per minute).
- Time Study: This is the fastest measured speed that the process can achieve. It is not an average, standard, or normal speed. It is the maximum operating speed (minimum cycle time).

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There are fundamental differences in how manual and automated systems capture cycle time loss, although both rely on an accurate Ideal Cycle Time.

Manual measurements of cycle time loss use a "mass balance" calculation with information typically captured at a granularity of shift or part:

Cycle Time Loss = Run Time - (Total Parts x Ideal Cycle Time)

III. CYCLE TIME REDUCTION

In today's competitive marketplace, achieving manufacturing excellence has become critical for success. This thesis addresses a key element of manufacturing strategy, the ability to compete on cycle time, and it addresses a fundamental measure of progress against that strategy.

The goal of this thesis is to provide specific examples of how to reduce cycle time.

The sensitized film industry has changed over recent years, and competitors threaten in almost every market. Worldwide capacity expansion is outstripping growth in demand, which is creating pricing and service pressure especially in the consumer films.

If JBML cannot supply the desired product at the desired time, a competitor will. In this new environment, cycle time reduction provides a key competitive advantage.

Reduced cycle time can translate into increased customer satisfaction. Quick response companies can launch new products earlier, penetrate new markets faster, meet changing demand, and can deliver rapidly and on tirne.3 They can also offer their customers lower costs because quick response companies have streamlined processes with low inventory and less obsolete stock. According to empirical studies, halving the cycle time (and doubling the work-in-process inventory tums~ can increase productivity

20% to 70%. Moreover, quartering the time for one step typically reduces costs by 20%.5

How Cycle Time Loss Affects Manufacturing Productivity

Cycle time losses are often hidden from view. They are frequently not tracked accurately (if at all) or acted upon effectively (if at all). There are a few reasons for this:

Equipment that is stopped gets greater focus than equipment that is running. As a result, down time and changeovers typically get a much higher level of attention than equipment that is running slower than its maximum operating speed.

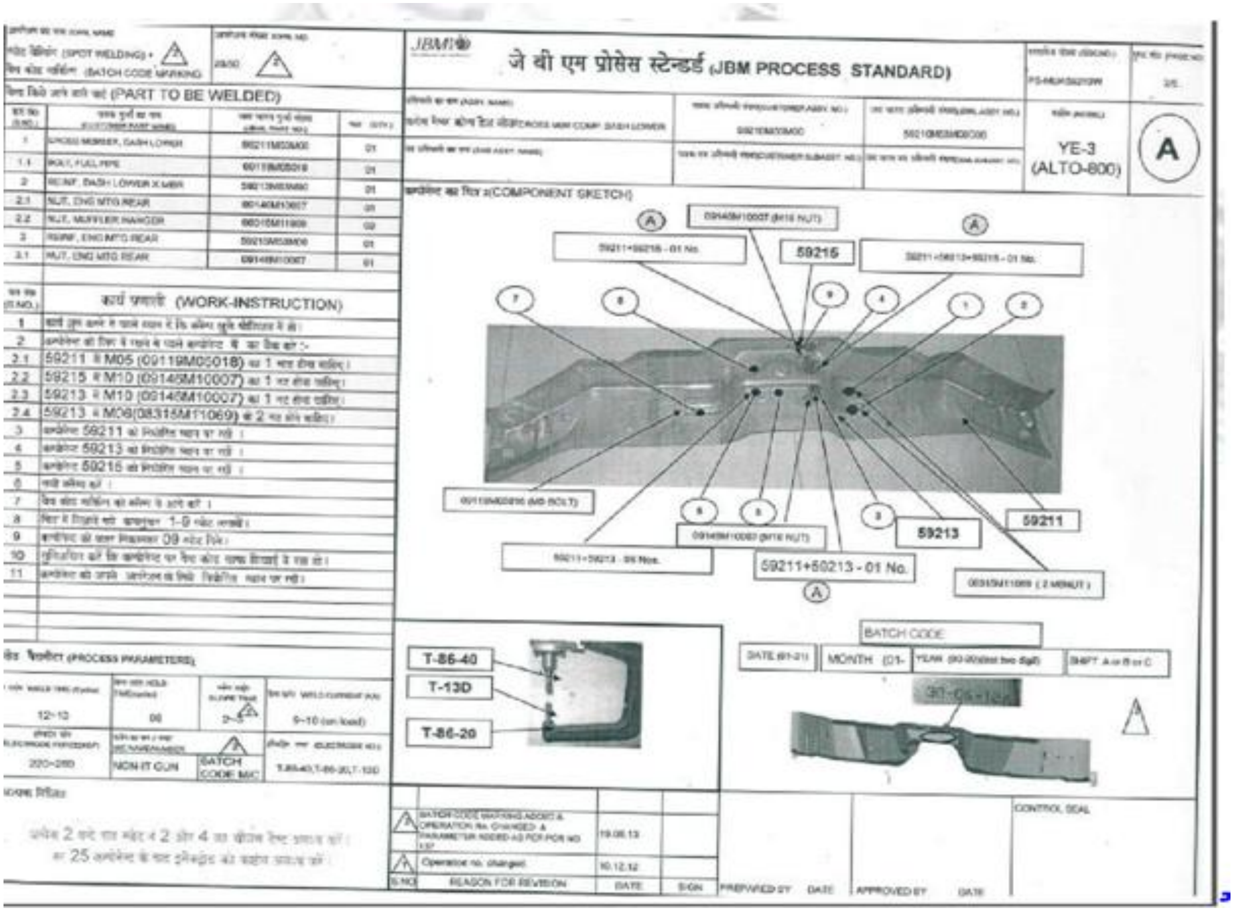
Cycle time loss is often built into standard production times, which can cause operators to run equipment slower than its optimal operating speed (“we've always run this way”).

Manual performance tracking (e.g., calculating OEE manually) relies on mass balance calculations that provides very little in the way of actionable details.

When equipment is configured to run slower than the Ideal Cycle Time, it is often a symptom of underlying equipment or material issues. For example, the operator may know that running slowly results in fewer jams or fewer rejected parts. Often, insufficient asset care and material quality issues are masked by running slower.

From the perspective of Overall Equipment Effectiveness (OEE) and Total Equipment Effectiveness (TEEP), cycle time loss is captured as a Performance Loss. From the perspective of the Six Big Losses, cycle time loss is captured as Reduced Speed (Slow Cycles) and Small Stops.

Operation No. 10/50



Similar operation also performed on YE-3 Dash.

Operation No. 20/50
Operation No. 30/50
Operation No. 40/50
Operation No. 50/50

IV. CYCLE TIME STUDY OF YE-3 DASH

Op/ No.	Spots	Method Of welding	Loading Time	Clamping Time	Welding Time	De-clamping Time	Unloading Time
10/50	1	Manual	11.56 13.21 14.11 11.56	-	3.69 4.10 6.80 3.69	-	-
20/50	9	Manual	4.98 5.08 5.12 4.96	1.49 1.46 1.52 1.45	11.75 11.89 11.73 11.79	1.49 1.56 1.52 1.45	3.24 3.76 3.28 3.56
30/50	4+4	Automatic	14.50 12.80 13.56 15.04	1.15 1.15 1.13 1.16	19.17 19.10 19.18 19.08	1.13 1.17 1.16 1.13	3.51 2.83 2.97 3.03
40/50	8+9	Automatic	5.77 6.72 5.66 6.49	3.44 2.66 2.69 2.83	28.60 28.45 18.42 28.49	3.40 1.30 1.28 1.41	12.29 5.40 5.41 5.91
50/50		Manual (Sealer)	3.93 2.82 2.91 3.30	-		-	

V. AVERAGE CYCLE TIME REDUCTION

Op/ No.	Spots	Method Of welding	Loading Time	Clamping Time	Welding Time	De-clamping Time	Unloading Time	Total Time
10/50	1	Manual Avg.	10.02	-	4.57	-	-	5.97
20/50	9	Manual Avg.	5.035	1.48	11.79	1.48	3.46	23.24
30/50	4+4	Automatic Avg.	13.97	1.14	19.13	1.14	3.08	38.46
40/50	8+9	Automatic Avg.	6.16	2.90	26.49	1.34	7.25	46.10
50/50		Manual (Sealer) Avg.	3.25	-	27.6075	-	4.35	35.2

VI. CALCULATION

Cycle time = 149.01

Bottleneck operation: 40\50

Calculation for parts manufactured:

Parts manufactured at 100percent efficiency:

Cycle time/bottleneck operation=149.01/46.14=3.229

Parts manufactured at 85 percent efficiency: (Normal efficiency) 3.229*.85=2.745

Now time taken in bottleneck operations: 43.14

VII. PROPOSAL GIVEN FOR REDUCING CYCLE TIME

Proposals made:

Proposal 1

To shift spot 4 welded by left robot in operation 30/50 to be welded in op 40/50.

Result: failed

No reduction in cycle time because Reason 1 :It is a py part

Reason 2 :It is not an bottleneck operation so no reduction in time.

Proposal 2 :

To shift spot one welded by robot Right in operation 40/50 to be welded in op 30/50 thus saving time.

Result**: successful**

Time reduced from bottleneck op. = 3 sec

Now time taken in bottleneck operations:43.14

VIII. CONCLUSION

We have done modification of YE-3 Dash (part of Maruti 800) in an assembly line production.
We have shift one spot which in operation 40/50 done by the robot to the operation 30/50 done by the another robot, so as to reduce the cycle time of the production by 3 sec.

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