Manufacturing Time and Cycle Time Reduction in CNC Machine Shop

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***Abstract*—The importance of cycle time reduction in CNC machines is must in modern world, which is longing for manufacturing cost reduction for the competitive market. First, many companies are trying to achieve Just-In-Time (JIT) benefits. They want each required component available at the point it is required, eliminating the need to inventory any of the related components. Since reducing cycle time will improve through-put of jobs, cycle time reduction is a major contributor to any serious JIT program. Second, reducing cycle time improves a company's flexibility. It helps them to run any job at any time without overtaxing setup people or machine tools. Third, of course companies want to improve profit margins. The faster a production run can be completed, the more profit a company can make. And forth, competition dictates that a company be able to quote the lowest possible price. Since most companies quote jobs based upon a machine's shop rate in Rupees per hour of use, they can quote lower (getting more jobs) if cycle time can be minimized the cycle time reduced is direct profit made without any capital investment and reduced labour.**

Index Terms— CNC machine, Solid Cam, Solid works

I. Introduction

The importance of cycle time reduction in CNC machines is must in modern world, which is longing for manufacturing cost reduction for the competitive market.

Cycle time: Cycle time is defined to be the time that takes to load, run, and unload on work piece. Production quantities in an industry dictate that the more work piece you run, the more important it is to achieve the goal of lowering the cycle time.

Setup time: The time taken to prepare the manufacturing processes and system for production.

Ideal time: It could also be associated with computing, and in that case, refers to processing time.

Component changeover time: The time required to place the work piece and clamping it in the fixture of machine tool after one operation cycle completes is called component change over time.

Cycle time reduction: To minimize the cycle time in these areas, there are two ways in which this can be achieved. The process engineer must select an appropriate machine tool, cutting tools, fixturing, and machining order in a way that it matches the number of work pieces to be machined that will be based on the production quantity. The cycle time will be a reflection of the processes being used to machine work pieces. To optimize cutting operations for this would involve properly selecting cutting tool materials, feeds, and speeds to machine work pieces as efficiently as possible with the current process.

Setup time reduction: Taking into account both costs and setup time, it is most efficient for the company to select the SMED method and to make improvements to the machines.

Idle time reduction: The company managers should properly schedule the work shift to reduce the idle time.

II. Changeover Reduction

Fixture changeover optimization: The second changeover operation that is optimized is that of attaching and detaching the fixtures. On average it takes 3.08 minutes to remove one fixture and attach the next fixture. Since there are two tables per machine, this means that attaching and detaching fixtures requires 6.16 minutes per changeover. The goal of this section is to minimize the number of fixtures that need to be attached and detached from the machines. The fixtures differ from the tools in that when a fixture is removed it is always replaced by another one. With the tools, it was necessary to find out how many tools were removed and attached because the number of tools being attached was not always the same as the number of tools being removed. Therefore, in the case of the fixtures it is only necessary to count how many fixture changeovers occur for the specified jobs.

Tool changeover reduction: The first changeover operation that will be optimized is that of attaching and detaching tools. In order to minimize the tool changeover time, the aforementioned macro will be used for both the unpaired and paired scenarios for all three product lines.The goal of this method is to arrange the jobs in an order that minimizes the number of tools that need to be loaded and unloaded. Since many of the components share tools, it is expected that there will be a reduction in changeover time when this method is applied. Product line C has 30 part numbers and uses, on average, 4.6 tools, which means that if no tools were shared then the jobs would require 138 tools. Since the 30 jobs only require 67 tools, this means that many of the tools are shared, and therefore a reduction in tool changeover time can be achieved. The optimized tool changeover time is 28.88 minutes which is representative of using both methods 1 and 2. This yields a time savings of 7.63 minutes. Minutes over 15 changeovers. The paired scenario is 5.75 minutes worse than the unpaired scenario. The time savings for the paired scenario is 10.06 minutes over 20 changeovers.

Zero point clamping system: The zero-point clamping system is an advance system to reduce the setup time z. This modular system meets the requirements of specific solutions

with the best-possible utilisation of machine capacity. Although the machine tool had to stop for the set-up time until now, the work piece can now be clamped and positioned on the pallet outside the machine tool.

III. I-MACHINING

With its unique patented "morphing spirals", intelligent separation and Moating, I-Machining provides you with the shortest cycle times in the industry. The cutting angle constantly adjusts between a minimum and a maximum value, while the feed is dynamically adjusted to ensure constant mechanical and thermal load on the tool. It saves 70% and more in CNC machining time extends tool life drastically.

IV. SOFTWARE USED

Computer aided designing: Computer aided designing (CAD) is used to design the component which is given to reduce the manufacturing time and the cycle time in the industry. The software used in this project is Solid Works. The design of the component is given below.

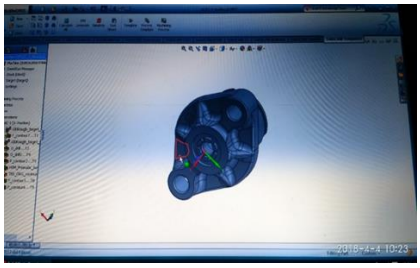

Fig. 1. Computer aided manufacturing: CAD is used to manufacture a component

V. TIME REDUCTION

Tools used:

- Uncoated carbide drill
- Uncoated Roughing end mill
- Uncoated Finishing end mill
- Uncoated Chamfering

Fixture used:

- Collet fixture

Material grade:

- ALUMINIUM 6061

TABLE I
COMPARISON OF OLD CYCLE TIME AND NEW CYCLE TIME

S.No.	Tool Used	Old Cycle Time [Min]	New Cycle Time [Min]
1	ENDMILL	8.50	4.42
2	BALLNOSE ENDMILL	2.10	0.2
3	DRILL	1.50	0.05
4	DRILL	0.33	0.01
5	ENDMILL	0.58	0.03
6	BALLNOSE ENDMILL	13.50	3
7	ENDMILL	3.55	0.63
8	ENDMILL	9.50	2.58
9	BALLNOSE ENDMILL	2.50	0.7
	TOTAL	**42.07**	**12.22**

TABLE II
MATERIAL PARAMETERS OF NEW CYCLE TIME

S.No.	Tool used	Diameter (mm)	Arbor Diameter (mm)	Angle	Number of Flute	Total Length (mm)	Cutting Length (mm)
1	ENDMILL	10	10	-	4	80	24
2	BALLNOSEENDMILL	8	8	-	2	80	24
3	DRILL	6.6	6.6	118	2	80	24
4	DRILL	5	5	118	2	80	24
5	ENDMILL	4	4	-	4	80	24
6	BALLNOSE ENDMILL	5	5	-	4	80	24
7	ENDMILL	1.98	1.98	-	2	80	24
8	ENDMILL	1	1	-	4	80	24

VI. CONCLUSION

Finally we have found that manufacturing and cycle time reduction in CNC machine shop can be in following ways.

Reducing the setup time using accessories like that presetter, zero point clamping system and OFFLINE programing.

Cycle time reduction can be achieved modern cam software like solid CAM, using high rapid moving CNC machines, machines with high speed tool change over time with tool scheduling using part changes or by quick work automatic HOLDING FIXTURES.

I-machining process which solid CAM claims, it save 70% of cycle time.

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