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## IMPLEMENTATION OF SINGLE MINUTE EXCHANGE OF DIE (SMED) IN INJECTION MOLDING MACHINE

N. KAWSARI



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## IMPLEMENTATION OF SINGLE MINUTE EXCHANGE OF DIE (SMED) IN INJECTION MOLDING MACHINE

N. KAWSARI

A reputed Ball pen industry in Bangladesh

Corresponding author & address: Nujhat Kawsari, E-mail: nujhat\_sadmani@yahoo.com  
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### ABSTRACT

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This work has been conducted with a view to bring out the best possible optimization regarding changeover time. Considering the budget constraint of the selected company, the target of this project was settled as to reduce the total changeover time as much as we can. The facets which have been taken under consideration are mostly quantitative; qualitative improvement of the changeover process is also done to some extent. So this report is rather a case study on implementation of SMED in a plastic industry where injection molding machines are used largely. The total process of the study intended to eliminate changeovers; in case of failure to eliminate changeover the target was reducing the necessary time to a minimal level. It is usual that people are found resistive to change. As the company has not practiced any form of lean management before, the first task was to change their mental set up about lean and SMED. So it was tough to make any drastic change. After recording the traditional changeover practice of the workers and analyzing the changeover process in a brainstorming session, the recommendations were made. The result is reduction of 50% time in changeover. Furthermore as there was a huge scope of improvement in the selected factory like some 5S as well as visual management related tasks are also performed.

**Key words:** LEAN Manufacturing, Single Minute Exchange, SMED

### INTRODUCTION

Continuous development is today's demand whilst limited resources are a deep-rooted challenge. The present world of competition requires making improvement by keeping in mind that with a very inadequate resource companies have to prove greater excellence; but limited recourse hardly means limited scope of perfection. Different tools of lean management permit us to minimize the production time by reducing process-wastes. SMED, which actually means single minute exchange of die, relates to quick changeover setup.

"Lean" in industry is more a philosophy rather a tool. It needs to exist more as a culture instead a set-up by externals. "Lean" is all about identification of wastes in processes and reduce/optimize it using many tools like 5S's, SMED, Visual Management, Value Stream Mapping, poka-yoke, Gemba etc. Lean principles are all centered on process improvement which leads ultimately to improved efficiency which leads to higher profitability. The concept is simple but getting there is usually harder than one can imagine (Rogstad 2010). One of the vast building blocks of Lean relates to quick changeover setup. The faster the changeover times, the less downtime of equipment. The DOWNTIME (Defect, Overproduction, Waiting, Non-utilized talent, Transportation, Inventory, Motion, Extra-processing) is the definition of the Eight Deadly Waste of a manufacturing environment.

SMED (Single-Minute Exchange of Dies) is a system for dramatically reducing the time it takes to complete equipment changeovers (Rahul *et al.* 2012). The essence of the SMED system is to convert as many changeover steps as possible to "external" (performed while the equipment is running), and to simplify and streamline the remaining steps. The name Single-Minute Exchange of Dies comes from the goal of reducing changeover times to the "single" digits (i.e. less than 10 minutes) (Norzaimi *et al.* 2012).

#### Necessary Definitions

**Changeover:** Changeover includes the time interval between the last good product produced before setup has started and the first good product produced after the setup has finished. This changeover can involve a number of small to large adjustments, re-supply of raw materials, and system checks before the machines are starting up again. Even after the machines have been started and materials used, operators may need to continue their adjustments to produce an item that meets the desired requirements.

**Internal task:** can be only carried out when the machine or process has stopped.

**External task:** could be while the machine or process is still in operating.

#### Scope of Work

The industry has not implemented any Lean tool before implementation of SMED. Their industry is growing large day by day and there was a plan for introducing some new injection molding machines for meeting the extended demand. The main challenge was to meet the extended demand by using existing machines. Moreover the company demanded for a standard process of changeover.

### MATERIALS AND METHODS

#### Methodology

Firstly a definite type of machine was selected for implementing SMED among all the machines available in the factory. A block of injection molding section had been primarily selected for carrying out the project. To make

any kind of change, it is important to know the present practice one is following. Statistical data were collected three times to maintain transparency. Data on changeover activities and changeover time was collected to find out the scope of work. Data collection was made by both interviews and video recording. After collecting data and internal analysis, a brainstorming session was arranged so that involved company can also fathom the procedure of development. The total changeovers have been divided into external and internal activities and the external ones are proposed to perform separately. After initiating some changes in the factory changeover time was recorded again to explore whether SMED really worked for them or not.

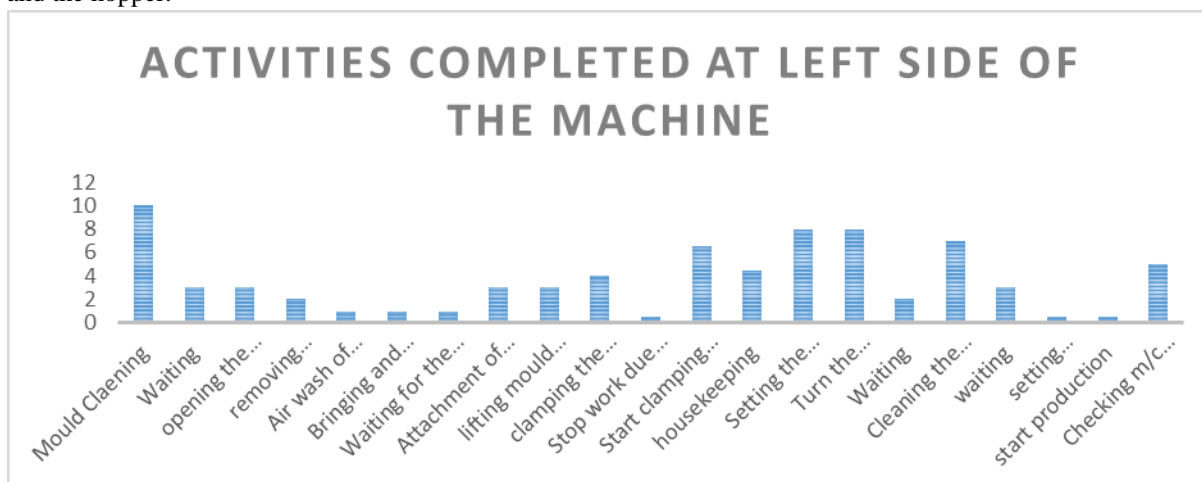
**Accomplishment of objectives**

To accomplish the targeted objectives for the study, the main strategy was to analyze the traditional working practice as well as find chances for development. All activities and decisions are taken after consulting the respective workers. For eliminating changeover an excel-based planning tool was introduced. I tried for reduction of changeover time where elimination was hardly possible by some changes in the traditional practices. Jobs that are external were strongly suggested to perform externally. To visualize a standard changeover process for the factory some training materials were provided.

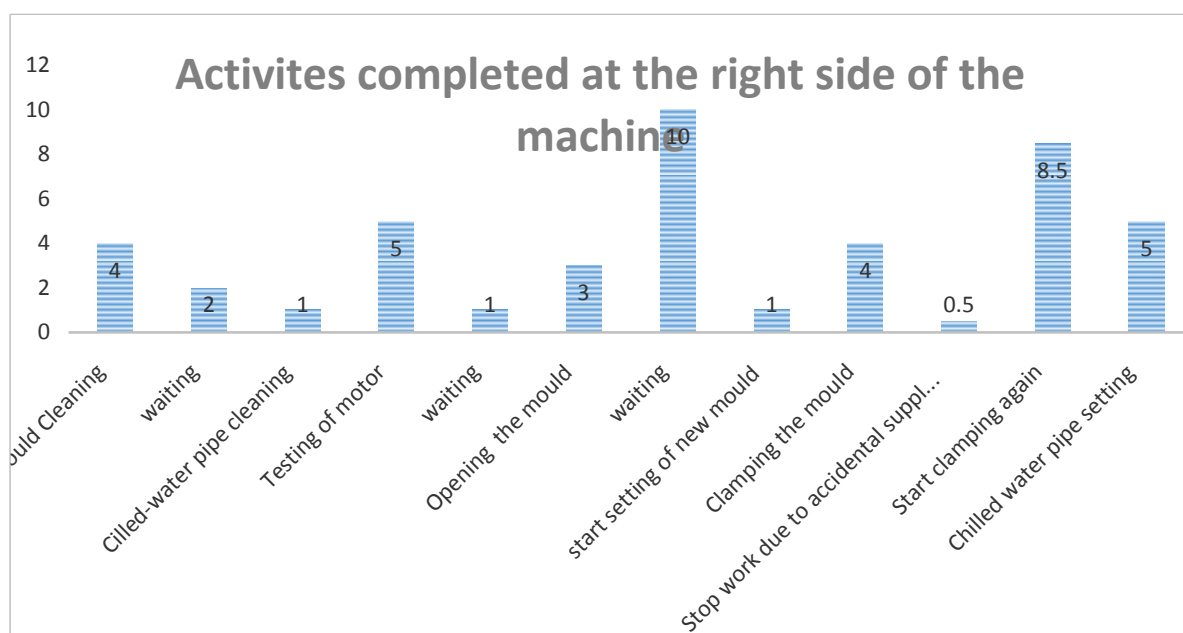
**Data Collection**

To maintain transparency, three changeovers were recorded among which one was a video recording. Workers spent almost 70 minutes for each changeover after they have the desired color. In case of color mismatch, the time extended and there was no target within which every changeover had to be finished.

The graphical representations given below presents the time spent previously at a work station. For the ease of calculation an injection molding machine has been divided into three major parts i.e. the left side, the right side and the hopper.



**Fig. 1.** Previous activities during a changeover at left side of the machine with time duration (Second) in detail



**Fig. 2.** Previous activities during a changeover at right side of the machine with time duration (Second) in detail

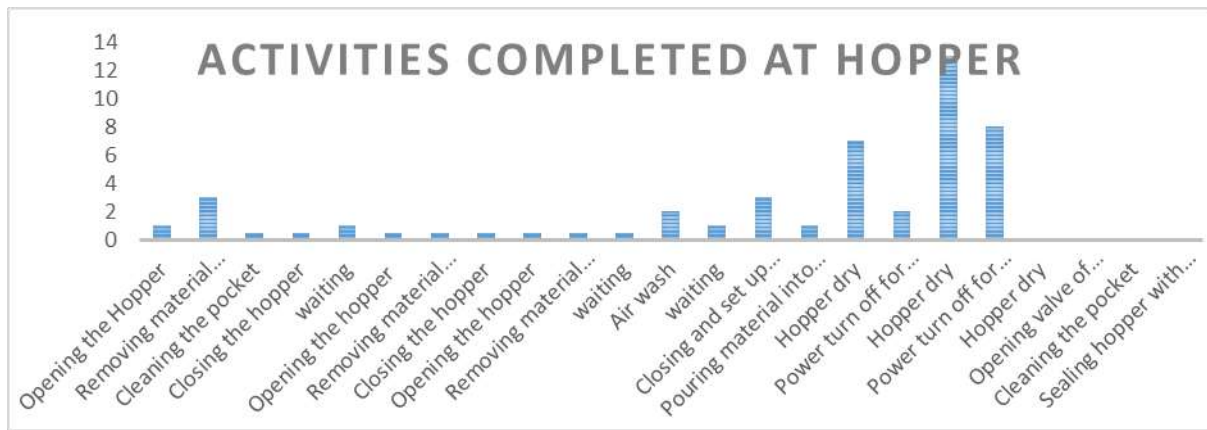


Fig. 3. Previous activities during a changeover at right side of the machine with time duration (Second) in detail

**Data Analysis**

Lack of planning and coordination were found as the major findings. The total time taken for a single changeover was 70 minutes including some unproductive waiting period. Again, though there were relatively fewer tasks to do in the hopper and the right side of the machine, man power allocation was not thoughtful enough. It is to mention that there were no color matching session which could have wasted another period of time. Suggestions were made according to the need assessment. Including the SMED related modifications, 5S, visual management and also poka yoke practices were decided to be applied for a better result.

**RESULTS AND DISCUSSION**

After working on the selected issues the changeover time was recorded again. The result of this project was the company experienced a 50% reduction of time of changeover. Several data has showed that workers are able to produce a new good product within 35-40 minutes after the last good product of the previous lot was produced. The company consider this result as a step towards continuous improvement. Given chart proves that at present only 30 minutes is needed to complete task at the left end where work load is at its best.

Activity	Start	End
Mould cleaning	8:30	8:33
Opening the mould	8:33	8:34
Removing mould from machine and bringing overhead crane	8:34	8:36
Air wash of mould and bringing new mold	8:36	8:37
Attachment of mould with lifting m/c	8:37	8:40
Lifting mould and start setting	8:40	8:42
Clamping the mould	8:42	8:45
Setting the nozzle of injection moulding m/c	8:45	8:50
Turn power source off, connecting motor and set receiving container	8:45	8:46
Cleaning the barrel of injection moulding m/c + checking the mould	8:50	8:54
Start production	8:54	8:59
Correction in setup of machine	8:59	9:00
Full production	9:00	

Fig. 4. Present activities during a changeover at left side of the injection molding machine

At the other two sides tasks are completed within these thirty minutes. There are thirty injection machines in that definite Ball pen Industry. On an average every machine goes through two changeovers a week. If every changeover now saves thirty minutes, in total the factory is able to save thirty hours a week.

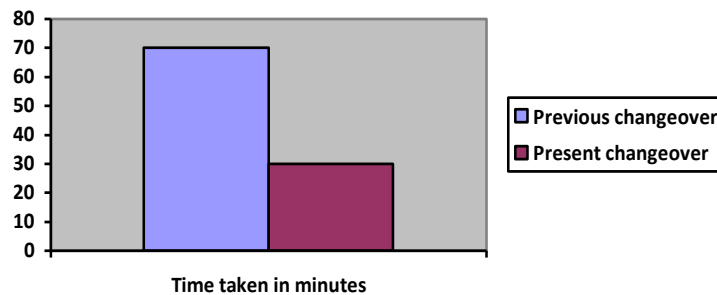


Fig. 5. Difference between time in previous changeover and present changeover

Single minute changeover time is yet a process to be accomplished. There are several reasons behind this. A small scale injection molding machine dedicated only for color testing and matching is not established as the management is taking time regarding this issue. Another reason that is liable for extended time for changeover is mold cleaning. The workers find it easier to clean the mold while it is attached with the machine. If there were any easier option to clean the mold externally, it would have saved a remarkable time.

## **CONCLUSION**

Changeovers add no value to the product; it is such a process for which the customers are not willing to pay. So the more we can save time from changeover operation, the more we will achieve productive time. Despite some stages that are yet to be implemented, the project was a success. The view of the workers towards lean as well as SMED is really encouraging. They are maintaining a communication board to highlight lean achievement. It can be easily said that the prime objective of the project has been achieved.

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