IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684,p-ISSN: 2320-334X
PP. 36-41
www.iosrjournals.org

SMED Implementation in a Press Shop

T.G.Arul[1], A.Manimaran[2], P.Ranjith[3]
[1]*Associate Professor, Department of Mechanical Engineering, CVR College of Engineering, Ibrahimpatnam, R.R.District, Hyderabad -501510, Telangana, India*
2Professor, Department of Mechanical Engineering, Vel Tech Technical University, Avadi, Chennai-600062, Tamilnadu, India.
3Junior Works Manager, Heavy Vehicles Factory, Avadi, Chennai-600054, Tamilnadu, India,

Abstract: *Globalisation has brought in cut throat competition in Indian Manufacturing Industries. To improve competitiveness, they started implementing operations management techniques like Lean Manufacturing, Total Quality Management (TQM), Total Productive Maintenance (TPM), etc. Single Minute Exchange of Die (SMED) is a lean manufacturing technique to setup time reduction that can be applied in any factory to any machine, originally introduced by Prof. Shigeo Shingo in*
Japanese industries in the 1950s and it is one of the principal elements of Toyota Production System (TPS) [8]. It was observed that the setup change takes 76 minutes in a 300T press shop, which is very high. Hence, it is decided to apply SMED concepts to reduce the setup changeover time and increase the Overall Equipment Effectiveness (OEE). Implementation of SMED involves five major steps viz., Evaluation of Current State of Changeover Process, Determination of Internal setup (Inside Exchange of Die) and External Setup (Outside Exchange of Die) operations, Conversion of Internal setup (IED) to External Setup (OED) operations, Streamlining Internal setup (IED) and External Setup (OED) operations and Standardization of complete setup change over process. SMED techniques like Standardised functions, Use of functional clamps, elimination fasteners altogether, Adopting parallel operations, Elimination of adjustments and Mechanisation have played a vital role in conversion of internal setup (IED) to external setup (OED). After implementation of SMED methodology, the setup changeover time is reduced from 76 minutes to a single digit minute, which has resulted in increased Availability that has lead to a significant increase in Overall Equipment Effectiveness (OEE).

Keywords: *SMED; Internal setup; IED; External Setup; OED; Setup changeover; Overall Equipment Effectiveness (OEE); Availability; Flexibility.*

I. Introduction

Globalisation has brought in cut throat competition in Indian Manufacturing Industries. To improve competitiveness, they started implementing operations management techniques like Just In Time (JIT), Total Quality Management (TQM), Total Productive Maintenance (TPM), etc. which resulted in increased productivity, quality, flexibility and reduced cost & delivery time. Single Minute Exchange of Die (SMED) is a scientific approach to setup time reduction that can be applied in any factory to any machine, originally introduced by Prof. Shigeo Shingo in Japanese industries in the 1950s and it is one of the principal elements of Toyota Production System (TPS). SMED is one of the lean manufacturing techniques implementation of which leads to increased Overall Equipment Effectiveness (OEE) by increasing the availability and increased flexibility by reducing waste in a manufacturing process due to setup changeover time, reduced cost by reducing the inventory. It provides a rapid and efficient way of converting a manufacturing process from running the current product to running the next product. This rapid changeover is the key to reducing production lot sizes and thereby improving flow. The phrase "single minute" does not mean that all changeovers and start-ups should take only one minute, but that they should take less than 10 minutes (in other words, "single digit minute") [10].

II. Literature Survey

Single Minute Exchange of Dies (SMED) is a comprehensive methodology that has often reduced setup times which took hours to less than ten minutes [1]. The implicit operating rules of the Toyota Production System (TPS) and its methodologies lead to lean tools such as Just In Time (JIT), SMED and Kaizen events[2][3]. Reducing lead time increases the overall capacity for future orders and customer demand [1] [4][5]. In a continuous flow production environment raw materials are converted through operations into the finished product. These individual operations directly impact the overall time it takes to complete a finished assembly and fill a customer order [6]. The adoption and implementation of single minute exchange of dies

(SMED) concept is a commonly used method to improve the overall setup process [4] [5]. SMED implementations allow for increased production capacity without adding additional equipment [5] [7]. Some of the SMED terminologies are discussed below:

- Setup Changeover: Time elapsed between the last piece in the run just completed until the first good piece from the process after changeover [10].
- External Setup or Outside Exchange of Die (OED):- That part of setup which can be done while the machine is still running [10].
- Internal Setup or Inside Exchange of Die (IED):- That part of setup which must be done while the machine is shutdown [10].
- Flexibility: To be able to respond very quickly to changing market demands, you need to be able to produce small lot sizes in an a economical way [9].
- Bottleneck Capacities: Reducing setup times increases the available capacity, Which can be interesting as an alternatives to buying new equipment or installing an extra shift in situations where the market demand increases [9].
- Overall Equipment Effectiveness (OEE) = Equipment Availability x Performance Efficiency x Rate of Quality Products

SMED methodology is adopted to reduce the setup changeover time and increase the Overall Equipment Effectiveness (OEE).

III. Smed Implementation In Press Shop: A Case Study

Step 1: Evaluation of Current State of Changeover Process.

In this paper SMED concept is applied for reduction of setup change over in a 300 ton press shop which consist of a Mechanical & a Hydraulic press. It was observed that OEE of press shop found to be very low (0.58). (OEE = 0.69 x 0.86 x 0.97 = 0.58) Availability was found to be very low (69%) when compared to Performance (86%) & Quality (97%). A detailed Pareto Analysis (Figure-I) was done on Availability losses and it is found that loss due to Setup change over is vital.

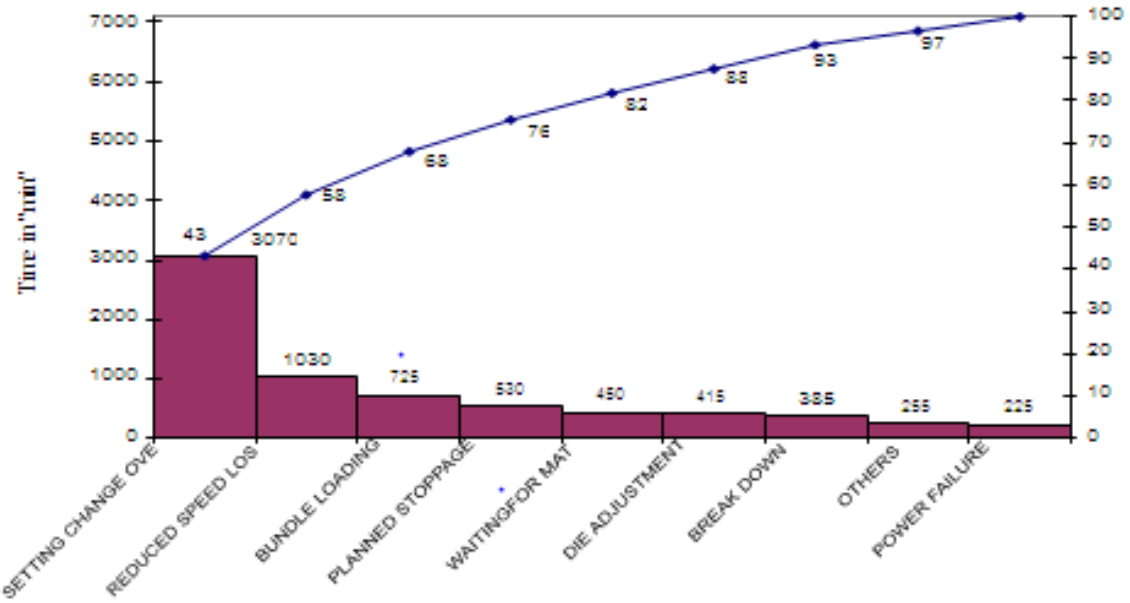

Figure-I Pareto Analysis of Availability losses

untrained, less skilled operators finds it difficult to change internal dies quickly as the operation sequence may go wrong. The losses in setup changeover is given in a cause and effect diagram (Figure-II) (also known as Ishikawa diagrams that can reveal key relationships among various variables, and the possible causes provide additional insight into process behavior) and 5 why analysis (an iterative question-asking technique used to explore the cause-and-effect relationships underlying a particular problem)

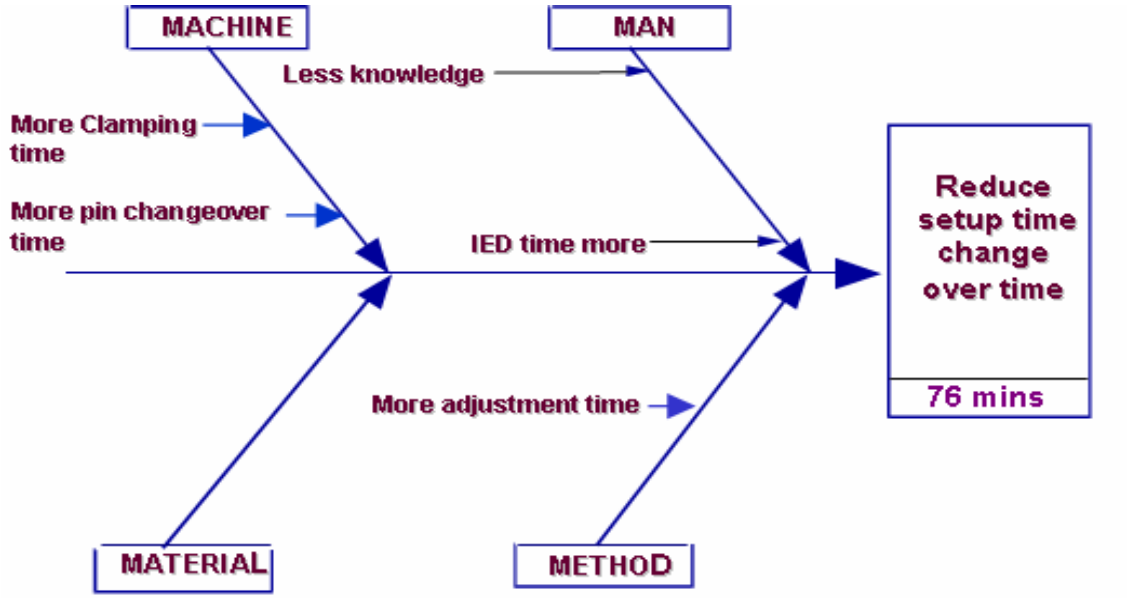

Figure-II Cause and Effect Diagram of Losses in Setup Changeover

Sl. No.	4M's	Cause	Why	Why	Why	Why	Why
1	Man	Less Knowledge	Less awareness	No proper training			
2	Man	IED time more	Improper utilization of manpower	No proper balancing of work content			
3	Machine	More clamping time	More work content	Manual clamping	Use of mechanical T-bolts		
4	Machine	More pin change over time	Struck up of pins	Manual change over			

Table-I Five Why Analysis

Current State of setup Changeover Process was evaluated & element wise time of setup change for 76 minutes was listed. It is observed that the entire setup changeover process was carried out after stoppage of machines (i.e. IED- 76 minutes & OED- 0 minute)

Step 2: Determination of Internal and External
Setup Processes

The second step consisted of determining the internal setup (IED) and external setup (IED) processes. This consisted of classifying each individual task from step one and categorizing them into internal and external processes. Based on a thorough study of elemental activities of setup changeover are Separated into Internal setup of 37 minutes (Inside Exchange of Die) and External Setup of 39 minutes (Outside Exchange of Die) operations. Details of activities which are indentified as External setup (OED) are given below (Table II):

Sl. No.	Activities	IED to OED Time in 'minutes'
1	Moving the tool change caution board to gangway	0.55
2	Clearing the work area by moving the pallets	14.7
3	Polishing the pressure pad top surface	2.92
4	Moving the pallets back to position	4.4
5	Removing the tool change caution board	0.7
6	Arranging accessories	1.45
7	Bundle stack changeover	14.28
	Total	39

Table-II Activities identified as External Setup (OED)

Step 3: Conversion of Internal and External Setup Processes

Focus is shifted to Conversion of Internal setup (IED) operations of 37 minutes to External Setup (OED) operations. Operations were re- examined to see whether any operation is wrongly assumed as internal setup and different ways were found to convert internal setup into external. Details of techniques applied for conversion of internal to external setup are given below:

1st by adopting parallel operations technique two persons were deployed in each press and ensured that work content is properly balanced and setup change takes place in both the presses simultaneously.

2nd by applying the technique called "Standardised functions", clamping pitch and clamping heights are standardized using common base plate for all press tools (Figure-III). It has resulted in reduction of internal setup time from 37 to 31 minutes.

Figure-iii Use of Common Base Plate

3rd by applying the technique called "Elimination of adjustments", Pin changeover in mechanical press is eliminated by adopting No Touch Exchange Method (Figure-IV), which has result in reduction of internal setup time from 31 to 20 minutes and clamping heights are standardized using common base plate for all press tools (Figure-III). It has resulted in reduction of internal setup time from 37 to 31 minutes.

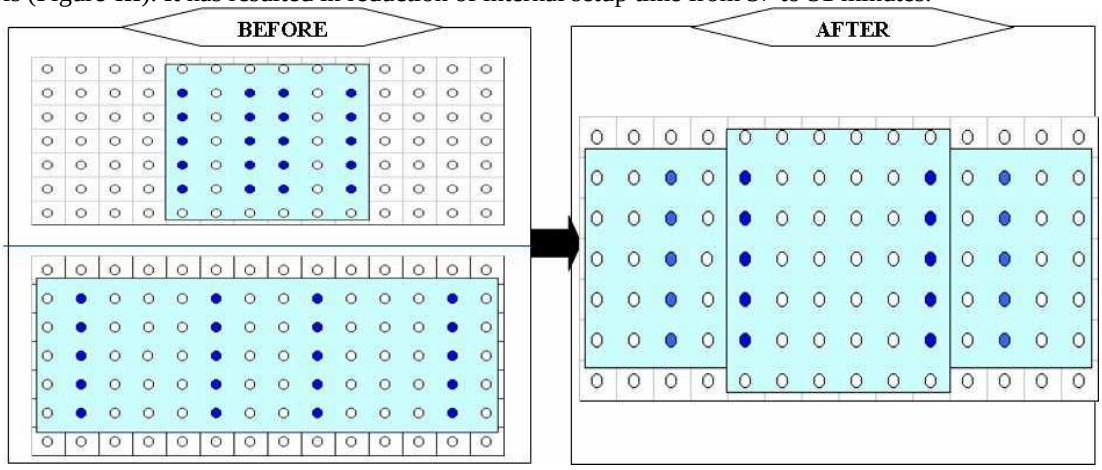

Figure-IV Elimination of Pin change over by adopting NTED

4th by applying the technique called "Use of functional clamps or elimination fasteners altogether", hydraulic clamping is introduced and usage of manual T-bolts are eliminated (Figure-V), which has resulted in reduction of internal setup time from 21 to 9.5 minutes

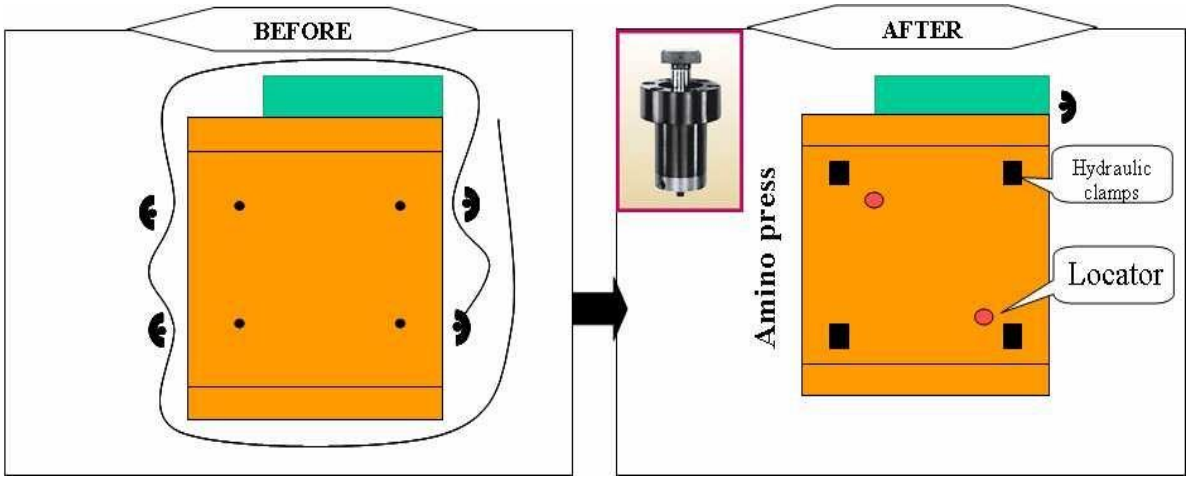

Figure-V Hydraulic clamping introduced

5th by applying "mechanisation" technique, manual tilting of conveyor tray is changed to pneumatic operated (Figure-VI), Which has resulted in reduction of internal setup time from 9.5 to 9 minutes.

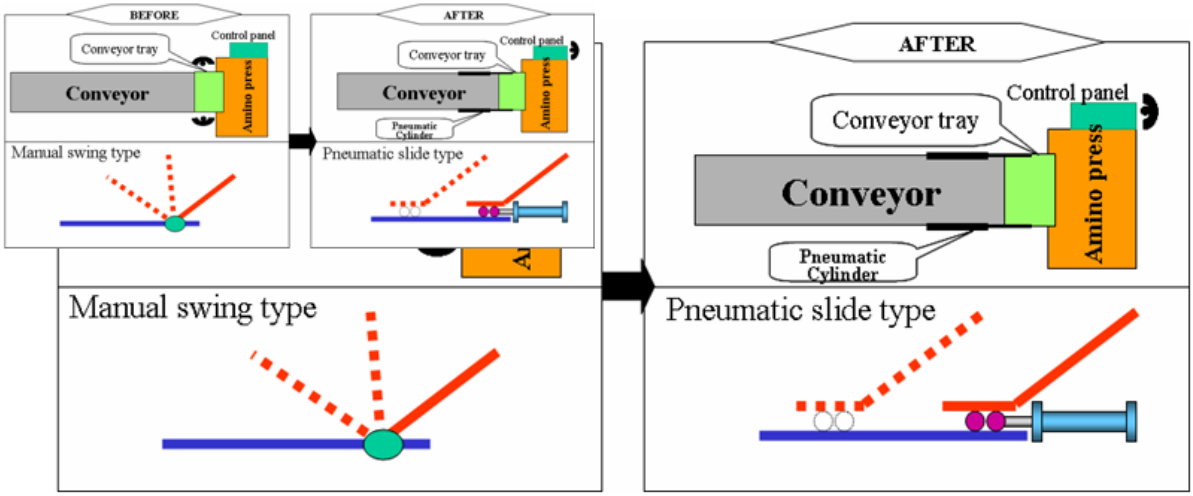

Figure-VI Pneumatically Operated Conveyor Tray

Step 4: Streamlining Internal And External Setup Processes

A concentrated effort was made to stream line the internal and external setup operations. A detailed analysis of each elemental operation is done. Elemental activities of Setup change over are clearly specified as internal and external setup operations. Proper training is imparted the operators based on skill matrix.

Step 5: Standardization Of Entire Setup CHANGEOVER PROCESS

Step five involves of standardization of (both internal and external setup operations) entire setup change over process. Due to the complexity of having multiple assembly procedures with specific changeover operations and three separate shifts standardized changeover documents specific to each process step is written and controlled. These documents include step by step instructions of setup operations and line clearance activities specific to the individual assembly station. In addition to the creation of the changeover documents all operators are formally trained. A standard training presentation was given to each shift. To ensure a consistent transfer of training anyone who absent during these training sessions are trained by means of "internal training" procedure which allows them to review and sign post formal training session. After the formal training sessions each employee will conduct a review of each document and sign off on training rosters. A controlled master copy of each changeover document and applicable training roster will be posted at each assembly station for reference and use during each future state changeover.

IV. Results And Discussion

After implementation of SMED methodology, the setup changeover time is reduced from 76 to 9 minutes (i.e. 88% reduction), which resulted 39% increase in Availability from 0.69 to 0.96 that had lead to 38% increase in Overall Equipment Effectiveness (OEE) from 0.58 to 0.8. (OEE= 0.96 x 0.86 x 0.97 = 0.8). It has resulted in enhanced capacity, increased Flexibility and reduced inventory of press shop.

With the above, it can be concluded that by implementation of SMED methodology and its techniques like separation of internal from external operations and conversion of internal to external operations, Standardised functions, Use of functional clamps, elimination of fasteners, Adopting parallel operations, Elimination of adjustments and Mechanisation, it is possible to reduce setup change over time in any factory in any machine from several hours to a single digit minute.

References

[1]. Robinson, A. (1990). Modern approaches to manufacturing improvement. Portland,OR: Productivity Press, Inc

[2]. Herron, C. (2007). Lean or Flabby? [Lean manufacturing]. Manufacturing, 86(5), 36-39. Retrieved from Academic Search Premier Database.

[3]. Ohno, T. (1988). Toyota production system: Beyond large-scale production. (New York, NY: Productivity Press, Inc.). Trans. (Original work published 1978).

[4]. Goddart, W. (1986). Just-in-time: Surviving by breaking tradition.Essex Junction, VT: Oliver Wright Limited Productions, Inc.

[5]. Shingo, S. (1989) Shigeo Shingo: A study of the Toyota production system (A. Dillion, Trans.) Portland, OR: Productivity Press, Inc. (Original work published 1981)

[6]. Shingo, S. (1988) Shigeo Shingo: Non-stock production: The Shingo system for continuous improvement (Productivity Press Inc, Trans.) Cambridge, MA: Productivity Press, Inc. (Original work published 1987)

[7]. Birmingham, F. & Jelinek, J (2007). Quick changeover simplified: The manager's guide to improving profits with SMED. New York, NY: Productivity Press, Inc

[8]. Shigeo Shingo (1985) A Revolution in Manufacturing: The SMED System (A. Dillon trans) Productivity Press, Cambridge, MA (Originally published in 1983)

[9]. Rahul.R.Joshi, Prof.G.R.Naik, "Reduction in Setup Time by SMED A Literature Review", International Journal of Modern Engineering Research (IJMER), 2012, ISSN: 2249-6645, pp 442-444.

[10]. Yash deve, Nagendra Sohani, "Single Minute Exchange of Dies: Literature Review", International Journal on Lean Thinking, 2012.

[11]. Rahul.R.Joshi, Prof.G.R.Naik, "Application of SMED Methodology- A Case Study in Small Scale Industry", International Journal of Scientific and Research Publications, ISSN 2250-3153, 2012.

[12]. António Carrizo Moreira,Gil Campos Silva Pais, "Single Minute Exchange of Die. A Case Study Implementation", Journal of Technology Management & Innovation, ISSN: 0718-2724,2011.

[13]. Domingos Ribeiro, Fernando Braga, Rui Sousa, S. Carmo-Silva, "An Application of the SMED Methodology in an Electric Power Controls Company", Proceedings of International Conference On Innovations, Recent Trends And Challenges In Mechatronics, 2011.