To Find Out the Present Barriers in Achieving Single Minute Exchange of Die in Hand Tool Industries

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INTRODUCTION
Manufacturing organizations that service of customers with demand for high diversity and low quantity must implement process improvements that align production capabilities with customer expectations. Production data for the hand tool organization indicates that over the past few years the punch presses in the forging department have been running at less than 80% efficiency.

Concept of SMED
The SMED system is a theory and set of techniques that make it possible to perform equipment setup and changeover operations in fewer than 10 min. SMED improves setup process and provide a setup time reduction up to 90% with moderate investments.

Definition of change of die
The time that elapses between the last good part being produced on one production run and the first good part being produced on the next following a changeover from one setup to another. Note that the parts should also be produced at the right pace.

The Conceptual Stages of SMED
Shingo identifies four stages in SMED application
0. Preliminary Stage: Internal and External Setups are mixed.  
1. First Stage: Separate Internal and External Setups.  
2. Second Stage: Convert Internal Setup to External Setup.
3. Third Stage: Streamline both Internal and External Setups.

Fig. 1.1: The conceptual stages of SMED

Objective of SMED
• Define Value from the customer’s perspective.  
• Identify the Value Stream needed to go from customer request to requirement delivered.  
• Ensure the product Flows through the value stream without delays.  
• Use Pull scheduling so that product is made only when the customer wants it (Just in Time).
Strive continuously to eliminate Waste from processes what wastes might be applicable to process changeover and set-up?

Benefits of SMED

- Less time spent on production.
- Machines have an increase in work rates. This means you actually get more work out of the equipment.
- Productivity sees an increase.
- Reduction in errors during set-up and after the machines starts back up. Fewer defects are produced.
- Inventory costs are minimal due to fewer raw materials needed. Also saves on space for storage.

LITERATURE REVIEW

Shingo, Shingo (1985): Single-Minute Exchange of Die (SMED) refers to the theory and techniques used for the reduction of equipment setup times. SMED has as its objective to accomplish setup times in less than ten minutes, i.e. a number of minutes expressed by a single digit.

Birmingham & Jelinek, 2007; Shingo (1987/1988): A creative method to increase employee utilization is to allow for employees to conduct parallel operations which will significantly reduce the amount of time to complete an entire operation such as a changeover.

Shingo, (1987/1988): Manufacturing wastes also exist in the form of unneeded or unnecessary processes or operations. Although processes may appear to be necessary or value added it can be found that some processes can be eliminated, combined, or transformed after a formal evaluation of the entire operation due to the fact that they do not add value.

Robinson, 1990: SMED was born over a period on nineteen years as a result of examining closely the theoretical and practical aspects of setup improvement. Both analysis and implementation are fundamental to the SMED system and must be part of any setup improvement program (Shingo, 1985).

Gill (2007): One of the most critical aspects to SMED implementation and transfer into production is operator training. There are five qualities organizations must possess in order for training to succeed. The five qualities include alignment, anticipation, alliance, application, and accountability (Gill, 2008).

Duggan 2007, King 2009: One of the key principles of operations management is determining the order variety and order size. In some cases lengthy change over activities dictate order campaigns; however setup reduction implementations derived from basic SMED principles significantly reduce the amount of lost capacity incurred during smaller lot sizes and configuration changes.

METHODOLOGY

Introduction

This project will focus on application of Shigeo Shingo’s Single Minute Exchange of Dies (SMED) methodology to reduce non-value added activities and reduce the time required to perform changeovers on punch presses within HAND TOOL Organization operating in the Ludhiana and Jalandhar belt. ANOVA test, effect size and regression test was performed for data analysis.

Objective of Study

- Study the single minute exchange of die methodology for finding the die setup time of hand tool organization.
- Study the various factors affecting the reduction of die setup time.
- Identify the barriers in reducing the wastage time during the die changeover process.

Questionnaire Development

This study based on hypothesizes that hand tool organizations setup time of die can be reduce by single minute exchange of die process. In order to examine the variables and barrier that affect the die setup time, this study takes small- and medium-size enterprises (SME’s) from the manufacturing organization in Jalandhar and Ludhiana belt.

Data Collection

A questionnaire was designed so that the variables and barrier that affect the efficiency of the die set up time can be analyzed. To study these variables, 50 organizations were identified in the Industrial hub of Punjab in the cities of Jalandhar and Ludhiana. Out of these, only 32 organizations provided the data regarding design questionnaire, which based on setup time of die process.

Data Analysis

The data collected using the questionnaire was analyzed using statistical analysis tools (SPSS), which defines the factors affecting the die setup time. The data collected from 32 organizations was divided in to five segments depending upon their setup time varying from 20 to 150 minutes. Also it helped us to find various barriers. For the analysis of data, One Way ANOVA, effect size and regression test are used to calculate the significance level of various factors.

DATA ANALYSIS AND RESULT

Data Analysis

Data was analyzed with the help of statistical tool. The analysis of the data was performed with the help of significant value of different parameters with respect to setup time and significant level between the groups and to get desired output. Parameters for die setup time are as follow:

- Advance planning.
- Employee participation and skills.
- Motion and handling.
- Effect on efficiency.
- SMED can be achieve in forth coming days.
The output given by data analysis against the various factors is discussed below:

At the start of analysis, data gathered from the questionnaire was converted and arranged in the form of bar chart and pie chart. Data is divided into five subgroups according to their die setup time (range from < 60 to more than 150).

1. Variation of different organization according to their setup time

Fig. 4.1: Variation of different organization according to their setup time

2. Number of organization focusing on different components of advance planning

Variables for advance planning are such as Tool is available near the machine (v1), Changing operation of die by manually (v2), Availability of back up (v3), Final inspection is done by quality department (v4), Equipment inspected before the starting the process (v5).

Fig. 4.2: Number of organization focusing on different components of advance planning

3. Number of organization focused on different component of employee participation and skills

Variables for employee participation and skills are such as Worker required changing the die (skilled)[v1], Training provided to unskilled workers[v2], availability of teamwork skill in workers[v3], Incentive[v4], Management satisfied with worker responsiveness[v5].

Fig. 4.3: Number of organization focused on different component of employee participation and skills

4. Number of organization focus on different component use for effective efficiency and sale growth

Variables for effect on efficiency and sale growth are such as Increase in sale growth[v1], Increase in production growth[v2], Customer satisfied with reduced delivery time[v3], Effect on overall growth[v4], Back up of die[v5], Use of parallel function[v6].

Fig. 4.4: Number of organization focus on different component use for effective efficiency and sale growth

5. SMED time can be reducing in forth coming days

Variables for SMED time can be reducing in forth coming days are such as satisfied with die setup time, want to reduce die setup time, Are you achieving universal time?

Fig. 4.5: SMED time can be reducing in forth coming days
6. Number of organization focused on motion and handling

Component of motion and handling such as Plant lay out, Position of tool room.

![Graph showing Plant layout need of parallel die setup]

**Fig. 4.6:** Number of organization focused on motion and handling

**One Way ANOVA Test**

In this project work questionnaire data is analyzed by one way ANOVA technique for finding which parameter is more significant towards the die setup time.

**Table 4.1: ANOVA Test Result**

<table>
<thead>
<tr>
<th>Factor No.</th>
<th>Factors Name</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1</td>
<td>Advance Planning</td>
<td>0.434</td>
</tr>
<tr>
<td>Factor 2</td>
<td>Employee Participation and Skills</td>
<td>0.043*</td>
</tr>
<tr>
<td>Factor 3</td>
<td>Motion and Handling</td>
<td>0.122</td>
</tr>
<tr>
<td>Factor 4</td>
<td>Effect on Efficiency &amp; Sale Growth</td>
<td>0.001*</td>
</tr>
<tr>
<td>Factor 5</td>
<td>SMED Can Be Reduce in Forth Coming Days</td>
<td>0.663</td>
</tr>
</tbody>
</table>

**Effect size**

Effect size is a value which allows seeing how much independent variable (IV) has affected the dependent variable (DV) in an experimental study. In other words, it looks at how much variance in dependent variable (DV) was a result of the independent variable (IV).

**Table 4.2: Effect Size**

<table>
<thead>
<tr>
<th>Factor No</th>
<th>Factor name</th>
<th>Effect size</th>
<th>% Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>factor 1</td>
<td>advance planning</td>
<td>0.1167</td>
<td>11.67%</td>
</tr>
<tr>
<td>factor 2</td>
<td>employee participation and skills</td>
<td>0.2872</td>
<td>28.72%</td>
</tr>
<tr>
<td>factor 3</td>
<td>motion and handling</td>
<td>0.1610</td>
<td>16.10%</td>
</tr>
<tr>
<td>factor 4</td>
<td>effect on efficiency and sale growth</td>
<td>0.3248</td>
<td>32.48%</td>
</tr>
<tr>
<td>factor 5</td>
<td>SMED can be achieve in forth coming days</td>
<td>0.1103</td>
<td>11.03%</td>
</tr>
</tbody>
</table>

**Result:** The ANOVA test and effect size of each factors shows that, factor 2 (employee participation and skills), factor 4 (effect on efficiency and sale growth), are more significant with die setup time. So these above factors are most appropriate to affect the overall die setup time.

**Regression Test**

Regression analysis is used to fit a predictive model to survey data and use that model in form of regression equation to predict value of dependent variables (die setup time) and established which factor are most important.

**Regression Equation**

Die setup time = constant + B1.factor 1 + B2.factor 2 + B3.factor 3 + B4.factor 4 + B5.factor 5  ...(equation: 1).

Die setup time = 8.748 - .081.factor 1 - .447.factor 2 - .216.factor 3 - .587.factor 4 - .184.factor 5  ...(equation: 2).

The regression equation 1 shows that die setup time will predict to decrease B value (Un standardized Coefficients) when the respective factor goes up by 1 unit and die setup time is predicted to increase constant value of Un standardized Coefficient (B) when all factors are zero.

**Table 4.3: Regression coefficients**

<table>
<thead>
<tr>
<th>Model</th>
<th>Unstandardized Coefficients (B)</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (Constant)</td>
<td>8.748</td>
<td>0.001</td>
</tr>
<tr>
<td>Advance planning</td>
<td>-.081</td>
<td>0.656</td>
</tr>
<tr>
<td>Employee participation and skills</td>
<td>-.447</td>
<td>0.001</td>
</tr>
<tr>
<td>Motion and handling</td>
<td>-.216</td>
<td>0.095</td>
</tr>
<tr>
<td>Eff. On efficiency and sale growth by reducing die setup time</td>
<td>-.587</td>
<td>0.001</td>
</tr>
<tr>
<td>Die setup time can be reduce in forth coming days</td>
<td>-.184</td>
<td>0.172</td>
</tr>
</tbody>
</table>

Finally employee participation and skills and effect on efficiency and sale growth, these two factors having large weightage score thus, this shows these two factors are most important to affect the die setup time.

**CONCLUSION**

Though there are lot of studies carried out in developed countries establishing the fact that there is positive effect of implementing SMED process on performance of die but not much studies have reported in the literature of Indian (SME’s). In this study the factors which depends upon die setup time are classified in to five groups, namely: advance planning, employee participation and skills, effect on efficiency and sale growth, motion and handling and die setup time can be reduce in forth coming days. However, The ANOVA test and effect size and regression test performed on each factors shows that, factor 2 (employee participation and skills), factor 4 (effect on efficiency and sale growth), are more significant with die setup time. So these above factors are most appropriate to affect the overall die setup time.
REFERENCES


