

Enhancing the Productivity of Printing Houses by Implementation of SMED (Single minute exchange of dies)

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Abstract:

The study investigates the methodology of reducing setup time and the importance of applying this methodology. The stages of application of this methodology by listing of all the operational stages that are carried out from the end of the last sheet printed down to get the first sheet printed correctly in the next job order. Then divide the operational stages into external stages and internal stages. The internal stages, which only take place when the machine stops. The external stages which can be done while the machine is running. With the study of the tools required to complete the adjustment. And then we study all processes in order to reduce the number of internal processes and we transfer some processes and stages from internal to external and thus reduce the time not used in actual production because it requires the machine to stop. Stages were studied to know their importance and what can be dispensed with and can be merged through other stages. Thus, defining only required stages for adjustment. Evaluate those processes in order to get to the best performance at as lowest time. The number of controls has been reduced by up to 50%, the total control time has been reduced by up to 73% and the number of operations that can be carried out during the work shift has increased to approximately 220%

Keywords:

*Setup Time
Registration
Job Order
Process Setting
Ok Sheet
Materials
Plats
Internal Process
External Process*

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1- Introduction:

The process of reducing setup time is one of the most important tools in the application of the lean production system or Toyota production system.

It is a methodology designed to achievement the setup process in a few minutes. The first appearance of that term was in 1960 Where in most automakers the molding process consumes the greater part of the production time It was usual to change molds takes more than a full day The first studied this problem was the Japanese engineer Shigo Shingo. The goal was to change the setting time to a few minutes this was in order for companies to benefit most from production capacity, which depends mainly on reducing unproductive time In order to become more efficient and most of the times that do not provide added value in the production process is setup time.

2- Research problem:

Changes in the nature of orders and Customer consumption strongly imposes on the nature of job orders Characterized by extreme diversity with reduced quantities and therefore the machine carrying a large number of job orders during the shift Which results in many setup process and variety with the multiplicity of operating orders and thus lead to the consumption of the actual

production time of the machines.

3- Research goal:

It became necessary to get the least time to adjust to carrying out the largest number of operations with the highest efficiency and quality in order to maximize the economic return of machines and production units within the printing companies.

4- Research importance:

The importance of research is the application of reducing the setup time methodology in order to increase the productivity of machines without the need to increase investments by the best use of the possibilities available to the printing company.

5- Research Methodology:

The researcher adopts an experimental descriptive approach based the study of reducing the setup time method (SMED) by execution practical experiments and measuring results and analysis.

6- Theoretical Framework:

1. Productivity:

Productivity means getting the largest percentage of outputs with the specific value of inputs.

In another definition, productivity is an indicator of the ability of different production elements to achieve a certain level of output measured by inputs that have been invested for productive purposes.

The importance of productivity lies in achieving the following objectives.

First: Produce the largest quantity of units produced with less effort and fewer resources, making the printing company more competitive in the market.

Second: increasing productivity leads to a reduction in operating costs, which is an important element in the total costs, which is reflected positively in low prices, low prices leading to increased demand and increased sales, thus increasing the cash flow inside the printing company and increasing profits.

Thirdly: increasing productivity in the short term will reduce the percentage of excess labor, but the success of the company and its achievement of profits in the medium and long term will expand and benefit from all manpower to make maximum use.

1-2 Measuring productivity:

Productivity, in general, is measured by the ratio of output to input

$$= \text{output} / \text{input}.$$

But this is a general measure. If we want to measure the productivity of one factor such as operating time, labor, raw materials or any other factors, the productivity of any factor of production = outputs/inputs of this factor only
 So it calls one-factor productivity.

We may need to measure productivity for a group of factors related to one process such as labor and time. Is called multi-factor productivity =

$$\text{Output} / (\text{labor} + \text{time}).$$

The process of measuring productivity contributes significantly to process of improving productivity through implementation of productivity improvement plans and setup processes in order to analyze the reasons for deviations from the plans.

1-3 Improving productivity

Improving productivity comes through controlling the relationship between outputs and inputs in several ways:

- Permanence the output without increasing, while reducing the input.
- Increase the output using the same input
- Increase the output more than the increasing of inputs
- decreasing the output more than decreasing of input
- Increase the output while reducing the input
- The application of reducing setup time methodology lead to the achievement of productivity improvement through achieving by the survival of outputs without increasing with reduction of inputs (output) here is process or job orders (input) here is reducing

operating time.

The second method by increasing outputs with same inputs and increase outputs achieved by increasing number of operations while keeping inputs (time shift) by reducing setup time will reduce the total time of operation, which increase the number of job orders.

2. Setup process:

The time taken to change from job order to another, or means the time taken for the process of setup to get acceptable printed sheet, in other words, setup time is the time between last sheet printed from job order and first sheet printed correctly from the next job order this called SMED (single minute Exchange of dies).

In order to control the time spent in the process, the process should be studied and analyzed for development and the methodology is adopted in several stages

2-1: Primary stage

This stage studies the current process by limitation the steps of the process, as well as the differences and causes of these differences and makes a comprehensive list of all the steps and timing of these steps.

2-2: first stage

- Separate internal settings and external settings.
 Internal settings: Operations are performed and the machine must be in a state of production stop to load with the second job order.

External settings: The operations that can be performed and the machine in the case of production in the previous job order.

- The aim of this stage is to classify the setup processes and determine whether internal setting or external setting. In this classification, the time taken to complete each operation is determined.
- Identify the tools used by the operators.

2-3: second stage

Converting internal settings to external settings In order for the methodology to be effective, we will find many processes that we can transform from internal to external.

2-4: third stage

At this stage develop all internal settings and external settings by reducing time or even removing some steps.

2-5: fourth stage

This is the flow or streaming of the setting processes through the execution of the final operations that are indispensable and the method of performing them simultaneously, which contributes greatly to the optimal exploitation of the available manpower as well as the available time.

7- Experimental study:

Experimental tools:

Job order Print Poster Sticker Quantity 1000 Size 50 * 70 cm Printing 4 color - Heidelberg 4 Color Machine – auto plate System –side setting tool – fixing plate tool - plate Remover - gasoline – Brush- watch.

Experimental description:

The practical experiments were carried out in the

printing process as the main process in the printing company these machines with high automation. It has auto plate system and ink control system.

8- Results:

The results of the preliminary and first stage together to identify all operations as well as the time is taken for each operation, specifying the nature of the implementation of these operations in terms of internal or external, as in Table (1)

Table (1) shows the study of the process before applying (SMED)

No.	Operation name	The timing of the operation	Time taken in minutes	Operation type
1	The previous operation is finished and the machine stop working	3.04		
2	Bring the new job	3.03/3.02	1	external
3	Bunching printing plats	3.04/3.3	1	external
4	Checking printing plats	3.05/3.04	1	internal
5	Adjust the ink through the control unit	3.09/3.07	2	internal
6	Take out the delivery table of the finished job order	3.09-3.08	1	internal
7	Move paper pallet other than the desired job order	3.11-3.09	2	internal
8	Bring a gasoline solvent	3.11/3.09	2	internal
9	Bring priests for cleaning	3.13/3.11	2	internal
10	Distribution of printing plates on printing units	3.14/3.13	1	Internal
11	Adjust the machine impression on the new paper thickness	3.18-3.15	3	internal
12	Adjust the feeding unit	3.19-3.15	4	internal
13	Washing blankets for all printing units	3.20/3.15	5	internal
14	Bring paper	3.22/3.02	20	internal
15	Adjust Paper stack	3.25/3.22	3	internal
16	Removing the printing plates is a finished process and installing the printing plates for the following job order	3.28/3.20	8	internal
17	Adjust delivery unit	3.28/3.25	3	internal
18	Get printing proof 1	3.31/3.30	1	
19	Chick first printing proof	3.32./3.31	1	internal
20	Bring cleaner solution for plates	3.35/3.32	3	internal
21	Washing four printing plates	3.40/3.35	5	internal
22	Re adjust for feeding unit	3.36/3.35	1	internal
23	Get printing proof 2	3.41/3.40	1	internal
24	Chick register marks in second printing proof	3.42/3.41	1	internal
25	Re adjust the register marks by control unit	3.44/3.42	2	internal
26	Get printing proof 3	3.45/3.44	1	internal
27	chick the chromatic values with the naked eye	3.46/3.45	1	internal
28	Get printing proof 4	3.47/3.46	1	internal
29	Re chick the chromatic values with the naked eye	3.48/3.47	1	internal
30	Re adjust register marks and color values	3.49/3.48	1	internal

31	Get printing proof 5	3.50/3.49	1	internal
32	Review printing proof 5 with the original file on the computer screen	3.52/3.50	2	internal
33	Final adjustment	3.53/3.52	1	internal
34	Get final printing proof	3.54	1	internal
35	The machine stops paper problems	4.05/4	5	internal
36	Finishing print job order	4.25/4.05	20	
Total job order time		109 Minutes		
Total actual print time		20 Minutes		
Total setup time		89 Minutes		
Total number of setup processes		34 processes		
Number of internal operations		32 processes		
Number of external operations		2 processes		

Stage II: Separation of operations with internal to external conversion

The second stage is the conversion of operations that are normally performed internal to external the conversion results were as shown in Table 2 and Table 3

• Operations that can be performed internally

Table (2) a description of the processes that can be implemented internally

No.	Operation name	The timing of the operation	Time taken in minutes	Operation type
1	Adjust the ink through the control unit	3.09/3.07	2	internal
2	Take out the delivery table of the finished job order	3.09-3.08	1	internal
3	Adjust the machine impression according to new paper thickness	3.18-3.15	3	internal
4	Adjust the feeding unit	3.19-3.15	4	internal
5	Washing blankets for all printing units	3.20/3.15	5	internal
6	Removing the printing plates is a finished process and installing the printing plates for the following job order	3.28/3.20	8	internal
7	Adjust delivery unit	3.28/3.25	3	internal
8	Get printing proof 1	3.31/3.30	1	
9	Chick printing proof 1	3.32./3.31	1	internal
10	Re adjust for feeding unit	3.36/3.35	1	internal
11	Get printing proof 2	3.41/3.40	1	internal
12	Chick register marks in printing proof 2	3.42/3.41	1	internal
13	Re adjust the register marks by control unit	3.44/3.42	2	internal
14	Get printing proof 3	3.45/3.44	1	internal
15	chick the chromatic values with the naked eye	3.46/3.45	1	internal
16	Get printing proof 4	3.47/3.46	1	internal
17	Re chick the chromatic values with the naked eye	3.48/3.47	1	internal
18	Re adjust register marks and color values	3.49/3.48	1	internal
19	Get printing proof 5	3.50/3.49	1	internal
20	Review printing proof 5 with the original file on the computer screen	3.52/3.50	2	internal
21	Final adjustment	3.53/3.52	1	internal
22	Get final printing proof	3.54	1	internal
23	The machine stops paper problems	4.05/4	5	internal

24	Finishing print job order	4.25/4.05	20	
Number of internal operations		23 processes		
Total internal operations time		48 Minutes		

• **Identify processes that can be performed externally**

Table (3) a description of the processes that can be implemented externally

No.	Operation name	The timing of the operation	Time taken in minutes	Operation type
1	Bring the new job	3.03/3.02	1	external
2	Bunching printing plats	3.04/3.3	1	external
3	Checking printing plats	3.05/3.04	1	external
4	Move paper pallet other than the desired job order	3.11-3.09	2	external
5	Bring a gasoline solvent	3.11/3.09	2	external
6	Bring priests for cleaning	3.13/3.11	2	external
7	Distribution of printing plates on printing units	3.14/3.13	1	external
8	Bring paper	3.22/3.02	20	external
9	Adjust Paper stack	3.25/3.22	3	external
10	Bring cleaner solution for plates	3.35/3.32	3	external
11	Washing four printing plates	3.40/3.35	5	external
Number of external operations		11 processes		
Total external operations time		41 Minutes		

• **Stage 3: Evaluation and study of internal processes**

To study and evaluate all internal processes in terms of their importance, the method of implementation and what can be dispensed with, found that observations.

- There is no inspection of the print plates well before the installation of the plates on the printing machine, which contributes to the possibility of errors during the setup process or during printing, which will stop the process of printing and lead to wasting time.
- There is no color proof, which makes the checking without reference to the naked eye, and this was shown in the multi print proofs.
- There is no inspecting to paper in quantity and quality before printing that causes multiple stops and this appeared in stops after the adjustment, as in the processes 21 and 35 of the table (1)

- Lack of interest in the arrangement and cleaning of the workplace and therefore moving tables during the operation, which consumes the work time this shown in process 7 in Table (1)
 - There is no preparing to the operating requirements of gasoline, cleaner solution and priests in the quantity required and in the right place and appear in process No. 20 in table (1)
 - Repeating the process of printing proof that leads to the consumption of time and materials.
- Reviewing the control process contributes to reducing the number of operations that do not add extra value to the process and thus contribute to the overall time of the control through those observations it was concluded that there are internal processes can be dispensed without affecting the quality.

Table (4) shows the processes that can be canceled

No.	Operation name	The timing of the operation	Time taken in minutes	Operation type
1	Chick register marks in printing proof 2	3.42/3.41	1	internal
2	Re adjust the register marks by control unit	3.44/3.42	2	internal
3	Get printing proof 3	3.45/3.44	1	internal
4	Re chick the chromatic values with the naked eye	3.48/3.47	1	internal
5	Review printing proof 5 with the	3.52/3.50	2	internal

	original file on the computer screen			
6	The machine stops paper problems	4.05/4	5	internal
Number of internal operations		6 processes		
Total internal operations time		12 Minutes		

And then the basic processes that were important for the setup process were specified as follows

Table (5) shows the internal processes that must be performed to complete setup

No.	Operation name	The timing of the operation	Time taken in minutes	Operation type
1	Adjust the ink through the control unit	3.09/3.07	2	internal
2	Take out the delivery table of the finished job order	3.09-3.08	1	internal
3	Adjust the machine impression according to new paper thickness	3.18-3.15	3	internal
4	Adjust the feeding unit	3.19-3.15	4	internal
5	Washing blankets for all printing units	3.20/3.15	5	internal
6	Removing the printing plates is a finished process and installing the printing plates for the following job order	3.28/3.20	8	internal
7	Adjust delivery unit	3.28/3.25	3	internal
8	Get printing proof 1	3.31/3.30	1	
9	Chick printing proof 1	3.32./3.31	1	internal
10	Re adjust for feeding unit	3.36/3.35	1	internal
11	Get printing proof 2	3.41/3.40	1	internal
12	chick the chromatic values with the naked eye	3.46/3.45	1	internal
13	Get printing proof 4	3.47/3.46	1	internal
14	Re adjust register marks and color values	3.49/3.48	1	internal
15	Get printing proof 5	3.50/3.49	1	internal
16	Final adjustment	3.53/3.52	1	internal
17	Get final printing proof	3.54	1	internal
Number of final internal operations		17 processes		
Total final internal operations time		36 Minutes		

- **Stage IV: Sequence and synchronization of operations**

Improve the performance of internal processes by reducing the time taken for operations and performing some operations concurrently or at the same time of other operations team work of the machine (Technical – assistant tech.1- assistant tech.2)

Table (6) Concurrent operations

Operations can be done simultaneously					
Operations of technical		Operations of assistant technical 1		Operations of assistant technical 2	
Time taken in minutes	Operation	Time taken in minutes	Operation	Time taken in minutes	Operation
2	Adjust the ink through the control unit	4	Adjust the feeding unit	1	Take out the delivery table of the finished job order
3	Adjust the machine impression according to new paper thickness	3	Adjust delivery unit	5	Washing blankets for all printing units

				8	Removing the printing plates is a finished process and installing the printing plates for the following job order
5	Total Time	7	Total Time	14	Total Time
Total time saved by synchronizing operations = total of less time (Operations of technical time + Operations of assistant technical 1 time) = 5 + 7 = 12 minutes					

1. From Table 6 the actual time taken for the adjustment process = Total time of the final internal processes - the time of concurrent operations = 36-12 = 24 minutes only
3. Calculate the ratio consumption the number of operations
Percentage of savings in the number of operations = Number of operations after applying SMED / number of operations before applying SMED = 17/34 = 50%
4. Calculate the time saving ratio
(Time taken before applying SMED - time taken after applying SMED) / time taken before applying SMED = (89-24) / 89 = 73%
5. The number of operations that can be performed during work shift before applying SMED(work shift = 8 hours)
The number of job orders during the work shift before applying SMED = Total working time during the work shift / Time taken for one job order before applying SMED = (8 * 60) / 109 = 4.4 job orders per shift
6. The number of operations that can be performed during work shift after applying SMED(work shift = 8 hours)
The number of job orders during the work shift after applying SMED = Total working time during the work shift / Time taken for one job order after applying SMED = (8 * 60) / 44 = 10.9 job orders per shift
7. Percentage of non-value added operations = Number of canceled operations / total number of operations = 6/34 = 17.6%

9- Recommendations:

1. Implementing the methodology of SMED has enabled the reduction of the number of operations carried out by about 73%
2. Increase productivity by increasing the number of operations at the same time of operation by up to about 220%
3. study operations in details leads to the discovery of weaknesses during the process

and then work to improve the performance of those stages

4. Analytical study of operations leads to the identification of processes that do not result in added value to the product and then can be canceled rate was about 17.6%
5. Analytical study of operations helps to maximize the added value of the process by reducing the time and thus reducing the cost of increasing the number of operations that can be achieved about 220%
6. the application of this methodology to all machines at all operational stages, which will have the greatest effect in raising the capacity of the machines

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