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Analyzing Gas Cylinders Changing Processes

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ABSTRACT: *This study provides a comprehensive analysis of a repetitive and a common job around the world which is changing gas cylinders. Changing a gas cylinder by a worker in a gas station could lead to back pain and fatigue. To improve the present method being used by the operators, we have to apply principal techniques of Work Study such as Method Study. After using various work study techniques, we were able to reduce the task time by 38 seconds which could yield a hug result on the worker's health and productivity.*

Keywords: *Time Study, Method Study, Predetermined Time Standards, Standard Practice Sheet, seudo technique, Motion Study*

I. INTRODUCTION

Changing a gas cylinder by a worker in a gas station could lead to back pain and fatigue. To improve the present method being used by the operators, we have to apply principal techniques of Work Study such as Method Study which is the systematic recording and critical examination of ways of doing things in order to make improvements. Thus it simplifies the job and develops more economical method of doing it. Furthermore, we will apply another principal technique to measure the work involved in the activity of changing a gas cylinder. The goal of the paper is to provide a guideline to gas stations by standardizing their activates and processes.

II. CURRENT PROCESS

We have selected gas cylinders' jobs because it is a repetitive and this kind of jobs is recommended to be studied by the Work Study scientists. In this job there are a lot of annoyance to the worker due to the fatigue that is resulted by the tough nature of work and due to the unsafe environment, as one mistake dealing with the gas cylinders may lead to an explosion and accidents. The following list shows the steps for changing gas cylinders' (table1).

a) Obtaining the gas cylinder from the car trunk.
b) Removing the regulator from the gas cylinder.
c) Rolling the gas cylinder.
d) Waiting the new gas cylinder.
e) Receiving the new gas cylinder.
f) Removing the plastic cover from valve.
g) Obtaining the rubber part.
h) Placing the rubber part inside the regulator.
i) Joining the regulator with the valve.
j) Checking the valve.
k) Placing the gas cylinder into car trunk.

Steps 1, 2, 6, 8, 9, 10, 11 are examined critically and it will not be alternated.
Step 3) is examined critically and we concluded the following:
The bench of the old (empty) gas cylinders should be replaced, so it will be located to the nearest point to the worker, and then he can load the bench with old ones smoothly with out the need of rolling cylinder (Purpose & place based).
Step 4) is examined critically and we concluded the following:
This step will be eliminated, because of the new location of the bench, so no need to waiting the new cylinder is need to be determined (Purpose & plan based).
Step 5) is examined critically and we concluded the following:
This step will be eliminated, also because of the location, so we can pick the new (filled) cylinder easily (Purpose & place based).

Step 7) is examined critically and we concluded the following:
The rubber part should be placed in a tool box, so it can be picked easily, instead of picking it from his pocket (Place based).

Table1: Current Method

FLOW PROCESS CHART			MAN / MATERIAL / EQUIPMENT TYPE						
CHART No. SHEET No. OF			S U M M A R Y						
Subjected charted:			ACTIVITY		PRESENT		PROPOSED		SAVING
ACTIVITY:			OPERATION TRANSPORT DELAY INSPECTION STORAGE						
METHOD: PRESENT/PROPOSED			DISTANCE (m)						
LOCATION:			TIME (man-min)						
OPERATIVE(s): CLOCK Nos.			COST LABOUR MAYERIAL						
CHARTED BY: APPROVED BY: DATE:			TOTAL						
DESCRIPTION	QTY.	DIST-ANCE (M)	TIME (min)	SYMBOLS					REMARKS
Obtaining the gas cylinder from the car trunk	1	1	0.07	.					
Removing the regulator from the gas cylinder	1	0.1	0.1	.					
Rolling the gas cylinder	1	0.3	0.07	.					
Waiting the new gas cylinder	1	——	0.3			.			
Receiving the new gas cylinder	1	0.15	0.05	.					
Removing the plastic cover from valve	1	0.1	0.075	.					
Obtaining the rubber part	1	0.6	0.08	.					
Placing the rubber part inside the regulator	1	0.05	0.03	.					
Joining the regulator with the valve	1	0.15	0.1	.					
Checking the valve	1	0.05	0.05				.		
Placing the gas cylinder into car trunk	1	1	0.07	.					
TOTAL	11	3.5	1	9	-	1	1	-	

III. IMPROVED PROCESS

A) First Development

The location of the bench should be rearranged to be near the worker as well as the upper side of the bench for the old (empty) gas cylinders, while the lower side of the bench will be for the new (filled) gas cylinders. This development is based on the principle that states "Definite and fixed positions/stations should be provided for all tools and materials to permit habit formation", and this principle is related to the principles of motion economy as related to the arrangement of the workplace.

B) The Second Development

Two gravity feed boards should be used, one for delivering the old (empty) cylinder to the container where the angle of the board should be between 10 and 20 degrees from the ground, and the end edge of this board should be covered with thick sponge so it can avoid the crash of cylinders. The second board is for obtaining the new (filled) cylinder, where the edge of this board is near to the worker and the board is closed by a partition. The stage of the workplace (the station) should be redesigned so its height will let the worker open the regulator, join it with the valve, and tie it without the need to bend to perform these operations and this on the basis of the principle that recommend to perform the motions at the lowest classification and this principle is related the principles of motion economy as related to the use of human body. A tool box should be placed on the nearest wall of the worker, which contains the rubber parts instead of searching for it in his pocket. In this development we have defined a rhythm for the worker to repeat the process in a smooth way. this based on the principles of motion economy as related to the use of human body where there is a principle says "rhythm is essential to the smooth and automatic performance of a repetitive operation. The work should be arranged to permit an easy and natural rhythm whenever it is possible".

Table2: Improved Process

FLOW PROCESS CHART			MAN / MATERIAL / EQUIPMENT TYPE					
CHART No. SHEET No. OF			S U M M A R Y					
Subjected charted:			ACTIVITY	PRESENT	PROPOSED	SAVING		
			OPERATION TRANSPORT DELAY INSPECTION STORAGE					
ACTIVITY:								
METHOD: PRESENT/PROPOSED			DISTANCE (m)					
LOCATION:			TIME (man-min)					
OPERATIVE(s): CLOCK Nos.			COST LABOUR MAYERIAL					
CHARTED BY: APPROVED BY: DATE:			TOTAL					
DESCRIPTION	QTY.	DIST-ANCE (M)	TIME (min)	SYMBOLS				REMARKS
Obtaining the gas cylinder from the car trunk	1	1	0.07	.				
Removing the regulator from the gas cylinder	1	0.1	0.1	.				
Putting the old gas cylinder on the upper of the bench	1	0.4	0.03	.				
Picking the new gas cylinder from lower side of the bench	1	0.3	0.025	.				
Removing the plastic cover from valve	1	0.1	0.075	.				
Obtaining the rubber part	1	0.6	0.08	.				
Placing the rubber part inside the regulator	1	0.05	0.03	.				
Joining the regulator with the valve	1	0.15	0.1	.				
Checking the valve	1	0.05	0.05				.	
Placing the gas cylinder into car trunk	1	1	0.07	.				
TOTAL	10	3.75	0.63	9	-	-	1	-

C) Current vs ProposedProcess

The following table shows a comparison between the current method and the proposed one.

Table3: Current vs Proposed

Activity	Present	Proposed 1	Saving	Present	Proposed 2	Saving
Operation	9	9	-	9	11	-
Transportation	-	-	-	-	-	-
Delay	1	-	1	1	-	1
Inspection	1	1	-	1	1	-
Storage	-	-	-	-	-	-
Distance (m)	3.5	3.75	-	3.5	3.9	-
Time (min)	1	0.63	0.37	1	0.55	0.45

From the above statistics we can conclude that the second method (development) is better than both of the present one and the first method (development).

For qualitative improvement we can use the seudoquantitative techniques which translates subjective judgments into numerical scores, and then uses a combination of scoring and weighting approach. The comparison between alternative 1 & 2 by using seudoquantitative techniques (by using a relative weight (0 to 1) and scored against each factor on a scale of (1 to 10).

Table4: Current vs Proposed (seudotechnique)

		Alternative 1		Alternative 2	
Factor	Weight	Score	Net	Score	Net
Body comfort	0.5	6	3	8	4
Job satisfaction	0.2	5	1	7	1.4
Customer satisfaction	0.3	5	1.5	8	2.4
Overall scores	-	-	5.5	-	7.8

Thus, we conclude that alternate method '2' is better than '1'.

IV. THE STANDARD PRACTICE SHEET FOR THE NEW METHOD

The table below shows the standard practice sheet for the new method.

Table5: Standard Practice Sheet

Product:	Equipment	
Operations:		
Working conditions:		
Operative:	Charted by: Date: Approved by: Date:	

EL	Left hand	Right hand	EL
1	Hold the spanner	Idle	1
2	Hold the spanner and the bottom of the cylinder while taking it from the car	Hold the head of the cylinder while taking it from the car	2
3	Hold the spanner and release the bottom of the cylinder while putting it on the ground.	Release the head of the cylinder while putting it on the ground.	3
4	Hold the head of the gas cylinder.	Open the regulator.	4
5	Put the regulator and the spanner in the toolbox.	Idle	5
6	Hold the bottom of the cylinder while putting it on the delivery board.	Hold the head of the cylinder while putting it on the delivery board.	6
7	Hold the bottom of the new gas cylinder while putting it on the ground.	Hold the head of the new gas cylinder while putting it on the ground.	7
8	Take the spanner and the regulator from the toolbox.	Take the rubber from the rubber part	8
9	Remove the plastic part from the valve	Idle	9
10	Hold the regulator to join it with the rubber.	Join the rubber into the regulator.	10
11	Tie the regulator to the valve by the hand	Untie the nut of the valve	11
12	Holding the regulator	Tie the regulator by the spanner.	12
13	Hold the spanner and check for the gas	Open the stopcock and close it	13
14	Take the cylinder by holding the bottom of the cylinder	Take the cylinder by holding the head of the cylinder	14
15	Release the bottom of the cylinder in the car.	Release the head of the cylinder in the car.	15

V. PREDETERMINED TIME STANDARD

Our objective is to find the standard time for the activity of changing a gas cylinder. To achieve the goal we will use one of the useful techniques of the work measurement, which is, predetermined time standard (PTS).

Predetermined time standards (PTS), also referred to as predetermined motion time systems (PMTS) or synthetic time standards, are advanced techniques which aim at defining the time needed for the performance of various operations by derivation from pre-set standards of time for various motions, and not by direct observation and measurement.

Table6: MTM Data Card

Code	GA	GB	GC	PA	PB	PC
-5	3	7	14	3	10	21
-15	6	10	19	6	15	26
-30	9	14	23	11	19	30
-45	13	18	27	15	24	36
-80	17	23	32	20	30	41
GW:1 per 1 kg						PW:1 per 5 kg
A	R	E	C	S	F	B
14	6	7	15	18	9	61

Table7: Predetermined Time Standards

Element	TMU	Code	Description
get the gas cylinder from the car trunk	61	B	Bend the body
	11	GW	Get the cylinder
put the gas cylinder on the ground	61	2B	Bend the body
	2.2	PW	Put the cylinder
remove the regulator by spanner	13	GA45	Get the cylinder
	14	A	Open the valve
Put the spanner and the regulator in the toolbox	15	PA45	Put the spanner and the regulator
Get the old gas cylinder from the ground	61	B	Bend the body
	11	GW	
Put the old gas cylinder on the delivery board	2.2	PW	Put the cylinder
	61	B	Bend the body
Get the new gas cylinder from the receiving board	61	B	Bend the body
	25	GW	Get the cylinder
Put the new gas cylinder on the ground	61	B	Bend the body
	5	PW	Put the cylinder
Remove the plastic cover	19	GC15	Remove the plastic
Get the spanner and the regulator from the toolbox	27	GC45	Get the spanner
Get the rubber part from the rubber box	23	GC30	Get the rubber
Put the rubber part on the regulator	26	PC15	Reach the parts
	3	PA5	Join
put the regulator on the valve	26	PC15	To the valve
	3	PA5	On valve
tie the regulator by spanner	13	GA45	Spanner
	14	A	tie
checking the gas by opening the valve	10	GB15	reach
	15	C	open
get up the gas cylinder from the ground	61	2B	Bend the body
	25	GW	Get the cylinder
put the gas cylinder in the trunk of the car	5	PW	Put the cylinder
	61	B	Bend the body
Total	**795.4**		

The Calculation of the Standard Time:
Mathematically, Standard Time (ST) is:
ST = BT + [BT * Allowances (in %)]

BT (Basic Time or Normal Time) = 795.4 tmu = 795.4* 0.006 * 60 sec = 28.63 sec
Allowances = 33%
ST = 28.63 + [28.63* 0.33] = 38 sec
Thus the Standard Time for the improved method (2) for the activity of changing the gas cylinder is 38 seconds.

VI. CONCLUSION

We have concluded the importance of Work Study and its techniques and tools to help and serve the society, including the industrial and non industrial sectors. In addition, we hope that the new method we developed and its standard time will be increasing the productivity and efficiency of the workers involved in the activity of changing gas cylinders. The standard time which we have defined should be followed by the workers to insure the productivity of the work and their comfort and health.

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