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Optimized Slab Cutting Process – A VE Case Study

Dr. Vijay Kumar Singh
School of Mechanical Engineering, Lovely Professional University,
Phagwara, 144411, India
Corresponding Author Email: vijay.24694@lpu.co.in

Abstract

Value Engineering is a proven tool to reduce cost of a product, process or services. Implemented properly it optimizes the cost keeping quality, reliability intact. This case is of optimizing slab cutting cost at a steel making plant. Value Engineering has eight steps; following those eight steps the cost was optimized.

Brief Description of the Project

The double torch cutting system at slab caster leaves a step of 10 - 15 mm at the slab ends. This step enlarges to a deep narrow crack at the exit of the roughing mill at HSM leading to longer crop ends than necessary.

In addition, lower cutting speeds of the torches results in higher fuel consumption and higher metal loss during cutting.

Recommendations

The slabs should be cut with a single torch with higher cutting speeds at the torch cutting Machine of LD # 2 and slab caster.

Savings

A savings of Rs. 2.7 crores/annum for 1 MT. production at HSM and 1.1 MT production at the slab caster is envisaged. No expenditure has been incurred for the implementation of the recommendations of the project. Only certain operating conditions (for e.g. DA & O2) pressure has been changed.

1. Introduction

Opticrop installed at strip mill to minimize crop loss revealed the possibility of further improvement in yield through certain corrective actions upstream at the slab caster. The front and the rear ends of the transfer bar develop irregular profiles after the roughing mill at strip mill.Crop generated amounts to about 1 % of the total production ofstrip mill.

A considerable portion of the crop in the transfer bar is due to the stepped profile of the incoming slabs generated due to misalignment between the lines of cut of the torches.

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On conducting a detailed study of the slab cutting process, it was also revealed that the cutting speed of the torch was not sufficient resulting in higher fuel consumption and higher metal loss during the cutting process.

Project selection.

The double torch cutting mechanism with sub-optimal cutting speeds at the TCM of steel making plant, Caster lead to the following problems

a. Steeped profile of the slab edges resulting in higher crop loss at strip mill.
b. Frequent choking of the nozzles.
c. Higher fuel consumption
d. Higher metal loss during the cutting process.
e. Thus the VE team examined the above problems and studies the entire process with a view to improving it. The improved cutting process would result in appreciable recurring savings owing to minimized crop loss, fuel consumption & metal loss.

V.E Job Plan

The team outlined the following job plan for study.

a. Information Phase
b. Function Phase
c. Creativity Phase
d. Evaluation Phase
e. Development Phase
f. Implementation Phase
g. Audit Phase

Information Phase

a. Brief Introduction of Existing System.

Slab cutting is done by means of oxyacetylene torches mounted on a carriage. Initially the carriage is in a raised position. The PLC with the aid of a length measuring device initiates a command to lower the carriage and rests it on the slab when cutting needs to be done. The motor moving the carriage is stopped and the carriage rests on the slab and moves along with it. This ensures no speed mismatch between torches and slab while cutting. The two torches start cutting the slab from either ends at a speed so that the entire thickness of the slab is cut. Cutting is to be completed within 8.3 m from the home position. A limit switch is there at this location. This is essential to be able to continue casting smoothly.

b. Problem Description

Due to the existing mounting arrangement of the torches in the machine, misalignment between the torches is inevitable. This results in a step formation in the slab edge. Step size varies from 10 – 15 mm. This nominal step in the slab formation in the slab edge. Step size

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varies from 10m -15 mm. This nominal step in the slab edge extends deeper into the material on rolling and appears as a notch / crack (Approx 100 -120 mm long) in the transfer bar. This leads to longer crop being cut.

Inaddition, owing to frequent choking of the nozzles of the torches, the cutting speed was sub-optimal. This led to higher metal loss during cutting.

C. Objective of this VE study

This VE study aims at improving the slab cutting process in order to overcome the above mentioned problems. This in turn implies substantial recurring saving to the company.

Function Phase

Process	Function		Basic (B)
	Verb	Noun	Secondary (S)
Slab Cutting Mechanism	Cut	Slabs	B
	Consume	Fuel (DA & O2)	S
	Generate	Metal Loss	S
	Generate	Crop	S

Function – Cost Worth Analysis

Function	Allocated Cost ' C	Function Worth ' W	Basis For Worth	Value Gap Rs.	Value Index (C / W)
Improve Slab Cutting Mechanism	9.11	5.92	Reduced Metal Loss. Reduced fuel consumption. Reduced crop loss	3.19	1.538

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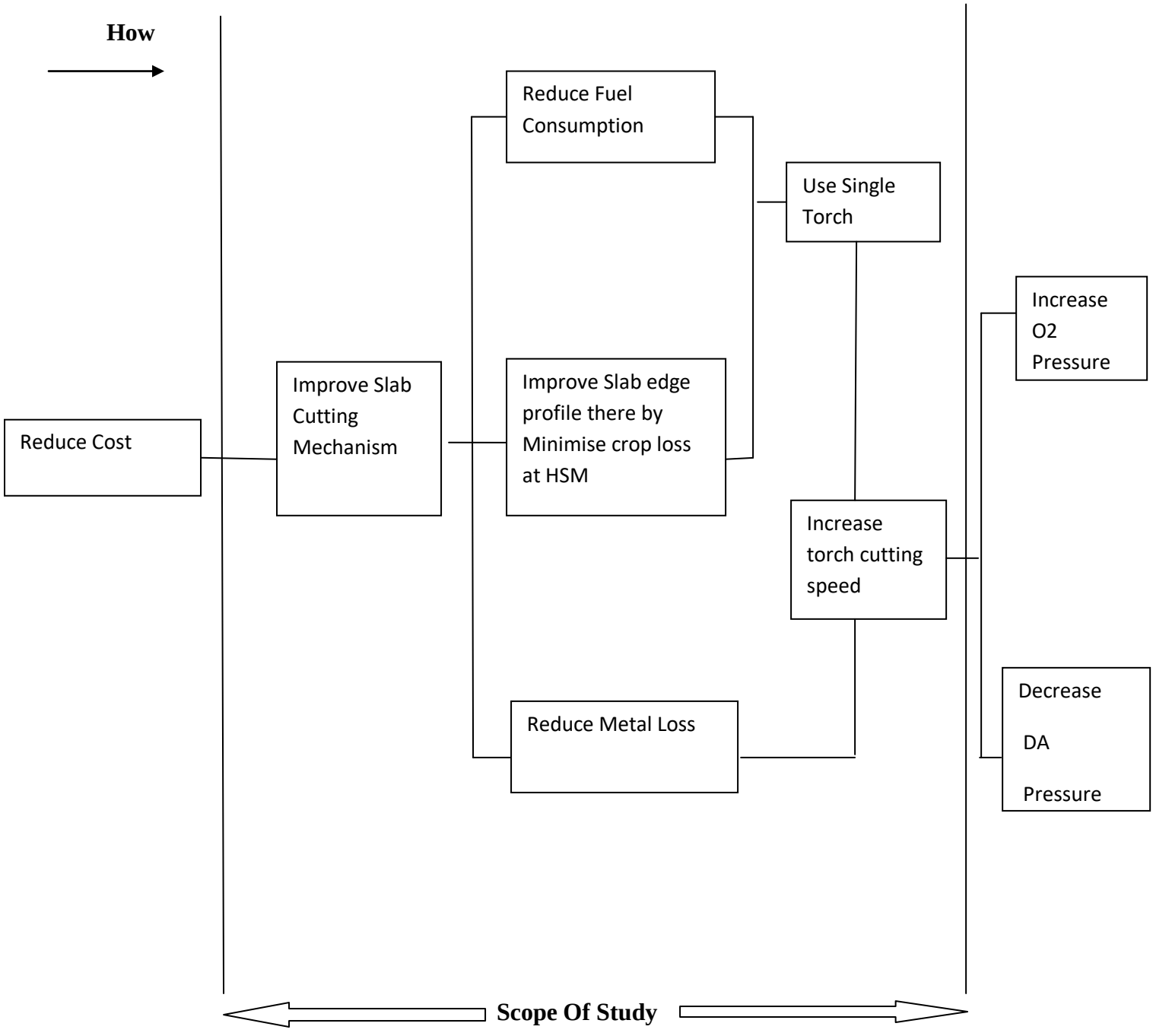
Fast Diagram For this Project



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Creative Phase

The following Ideas were generated

S. No	Ideas Generated	Ideas Selected / Rejected after critical evaluation
1	Cutting the slabs with single torch rather than two torches at higher cutting speeds	Selected
2	Modification of mounting arrangement of the torches to ensure perfect alignment	Selected
3	Change the PLC program to shift the meeting point	Selected
4	Use other metal cutting mechanism like Laser cutting / Plasma cutting	Rejected
5	Use of other natural gases of Propane instead of DA to reduce fuel cost	Rejected

Evaluation Phase

Based on information & experience the team decided the following criteria to evaluate alternatives.

Identity	Criteria	Score	Rank
A	Reliability	9	1
B	Ease of Implementation	1	5
C	Sustainability	5	3
D	Maintainability	2	4
E	Cost Reduction	6	2

	B	C	D	E	Weightage
A	A3	A2	A2	A1	8 + 1 = 9
	B	C2	D1	E2	0 + 1 = 1
		C	C2	E1	4 + 1 = 5
			D	E2	1 + 1 = 2
				E	5 + 1 = 6

Major Difference : 3

Medium Difference : 2

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Minor Difference : 1

No Difference : 0

Decision Matrix

5 Point Scale	Desired Criteria	Reliability	Ease of Implementation	Sustainability	Maintainability	Return on Investment		Ranking
Proposal	Weightage for Criteria	A	B	C	D	E	Total Score	
		9	1	5	2	6		
1. Cutting of Slabs with single torch at higher cutting speeds		5	5	5	5	5	115	1
		45	5	25	10	30		
2. Modification of the existing mounting arrangement of the torches to ensure perfect alignment		2	3	2	1	3	51	III
		18	3	10	2	18		
3. Change the PLC program to shift the meeting point of the two torches from the centre to more towards side		3	2	4	3	2	67	III
		27	2	20	6	12		

5 point Scale

Excellent = 5 Very Good = 4 Good = 3 Fair = 2 Poor = 1

Based on the total score out of the 3 proposals shown in the decision matrix, the first proposal (i.e cutting the slabs with the single torch at higher cutting speeds) was selected for implementation.

Implementation phase

The recommendations of the project have been implemented. The following changes were made.

a. Increased O2 pressure.
b. Reduced DA pressure.
c. Introduced better cleaning practice of nozzles.

Audit Phase

A savings of 35% of the earlier cost was achieved.

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Conclusion

Value engineering methodology is a very effective tool to reduce cost and improve team effort.

Reference

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