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IDENTIFYING THE BOTTLENECKS & INCREASING THE PRODUCTION OF FINISHING AREA IN A STEEL MANUFACTURING PROCESS INDUSTRY – A CASE STUDY

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ABSTRACT

The motive of this paper is to present an overview to identify the *bottlenecks & increasing* the production in a finishing area of a mill. As it was well known that the rolling area has higher production than the finishing area of the mill. Therefore, with the help of various work study & time study methods, ABC analysis & Fish-Bone analysis & other tools & techniques of industrial engineering, which are one of the most influential & most effective methodologies for eliminating delays associated with the working process in the finishing area of a mill. This methodology helps in identifying the bottlenecks and also finding the NAV (Non-added values) attached with this finishing area of a system. And henceforth this paper concludes with the suggestions as to take the necessary action for improving overall performance of a system with the complete assurance of large annual profit margins. This prescriptive paper proposes genuine solutions & results into increment in production of the mill.

KEYWORDS: Steel Manufacturing & Processing, Finishing Area, Rail, inspection, Work study, increasing production, Fishbone Diagram, ABC Analysis.

INTRODUCTION

The production can be increased by removing a NAV (Non-added value) from the system of a mill. Making the process more fluent by removing the NAV's is a better option as getting fewer changes and removing the barriers from a system. For Identifying the NAV's, work & Time study method can be used. After finding NAV's, with the help of ABC analysis, the major NAV's contributors in the system can be analyzed.

Objective

- To identify the area and causes of bottlenecks in the system.
- To identify all delays occurs in the finishing process.
- Analysis of reasons behind delay.
- To study the existing system and gives scope of improvement of the existing system and also provide the valuable suggestions for improving the existing system which will be helpful.

EXISTING SYSTEM LAYOUT

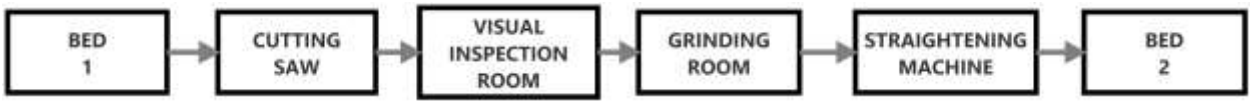

Fig. System Layout of Steel Finishing Process

The whole process of the inspection line in the finishing area of mill, must be understood before starting the study. The above layout shows the flow of unfinished product, i.e. rail from bed-1 to finished product on bed-2.

During observation and time study, different types of activities performed during rail inspection process. These are;

1. **Inspection**: - Inspection was done multiple times of rail in a visual inspection room by QA/QC employees who are linked with this activity.
2. **Chipping & Filing**: - To make trim/chip/smooth on the rail when needed in the visual inspection room.
3. **Cutting Saw**: - To cut the end parts of the rail.
4. **Grinding**: - To refine or to give smoothing to rail when needed.
5. **Pressing**: - To make straight with the help of pressing machine/straightening machine.
6. **Stamping**: - To give ID through stamping to the rail after the inspection process.
7. **Color Coding**: - To give the grade to the rail with the help of color by marking different lines on it with different color.

During observation, different types of delays performed during rail inspection process were noticed. These are;

1. **Communication delay between Control Operator and Cutting Operator:** Due to improper communication between them, which makes delay in movement of rail & cutting of rail.
2. **Communication delay between Control Operator and Crane Operator:** Due to improper communication between them, which makes delay in movement of rail.
3. **Communication delay between Control Operator and Press Operator:** Due to improper communication between them, which makes delay in press of head and tail of rail.
4. **Communication delay between Control Operator and Grinder:** Due to improper communication between them, which makes delay in grinding of rail.
5. **Shift Changeover:** Shift Change makes the process non- workable if the person was late.
6. **Blade Changeover:** Blade of carbide saw is changed when there is a need of cutting saw which causes delay in the work.
7. **Rail Shifting:** The time taken to shift the rail from bed to track.
8. **Bed B2 Jam:** Collection bed is full.
9. **Miscellaneous Delay:** Another delay like housekeeping, snacks, etc. which causes interference in the process.

CASE ANALYSIS

With the help of work study, systematic collection of the data can be done. The observation sheet of inspection of rail is summarized & mentioned below;

SUMMARY OF OBSERVATION SHEET				
Description	**Person A**	**Person B**	**Person C**	**Total**
	(in mins.)	(in mins.)	(in mins.)	(in mins.)
Nos. of rail observed	15 pieces	6 pieces	7 pieces	28 pieces
Total duration of observation	2319	829	994	4142
Total working time	2050	524	800	3374
Total Delays	**269**	**305**	**194**	**768**

Table. Summary of Observation Sheet

After the collection of data, focus on each and every delays and finding out their contribution was main concern of this study. For this, all data are analyzed closely and the summaries of delay of complete observations are mentioned below:

Sr. No.	SUMMARY OF TOTAL DELAY	Person 1 (in mins.)	Person 2 (in mins.)	Person 3 (in mins.)
1	Communication delay between CRO and Cutting Operator	40	29	15
2	Communication delay between CRO and Crane Operator	10	0	0
3	Communication delay between CRO and Press Operator	24	0	0
4	Communication delay between CRO and Grinder	35	13	0
5	Shift Changeover	48	28	56
6	Blade Changeover	9	0	25
7	Breakdown	27	42	0
8	Rail Shifting	29	0	0
9	Collection Bed B3 jam	40	0	45
10	Due to measurement and marking	0	0	114
11	Miscellaneous Delay	57	44	38
	Total	**319**	**156**	**293**

Table. Summary of total delays in minutes

Pie – Diagram:

After identifying the total types of delays from the summary tables, pie chart was generated to find the delays with maximum proportion.

Sr. No.	Delay Reasons With Code	Total Delay(min)	Percentage Contribution
1	Communication delay between CRO and Cutting Operator(D1)	84	10.9%
2	Communication delay between CRO and Crane Operator(D2)	10	1.3%
3	Communication delay between CRO and Press Operator(D3)	24	3.1%
4	Communication delay between CRO and Grinder(D4)	48	6.3%
5	Shift Changeover(D5)	132	17.2%
6	Blade Changeover(D6)	34	4.4%
7	Breakdown (D7)	69	9.0%
8	Rail Shifting(D8)	29	3.8%
9	Collection Bed B3 jam(D9)	85	11.1%
10	Due to measurement and marking(D10)	114	14.8%
11	Miscellaneous Delay(D11)	139	18.0%
Total		**768**	**100%**

Table. Percentage contribution of delays

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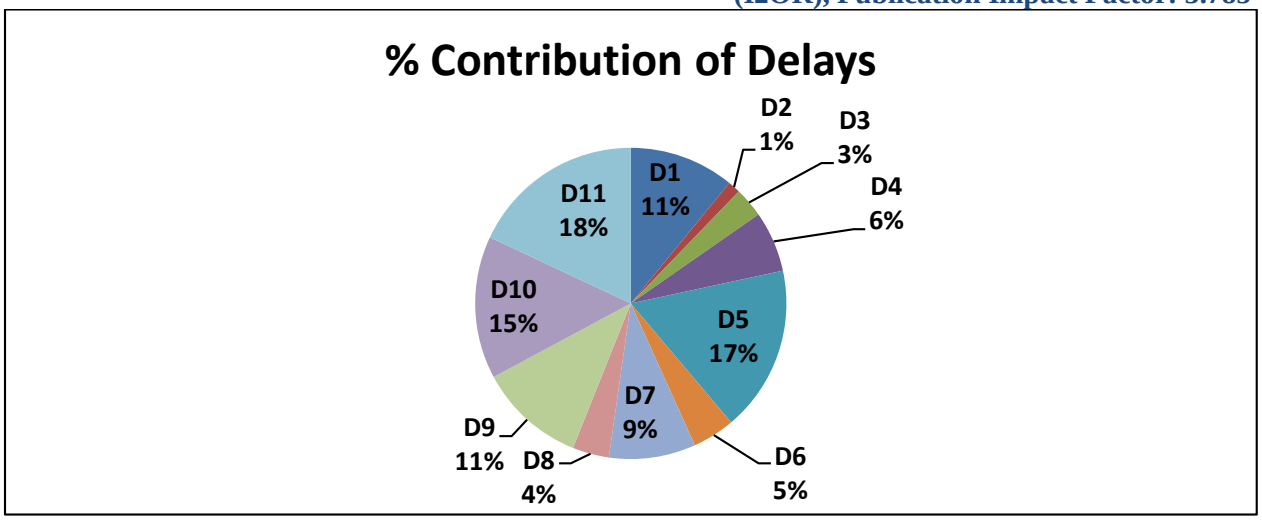

Fig. Pie Chart showing % contribution of delays

Fishbone (Ishikawa) Diagram :

The Fishbone diagram identifies many possible causes for an effect or problem. It can be used to structure a brainstorming session. It immediately sorts ideas into useful categories. It is also known as cause and effect diagram.

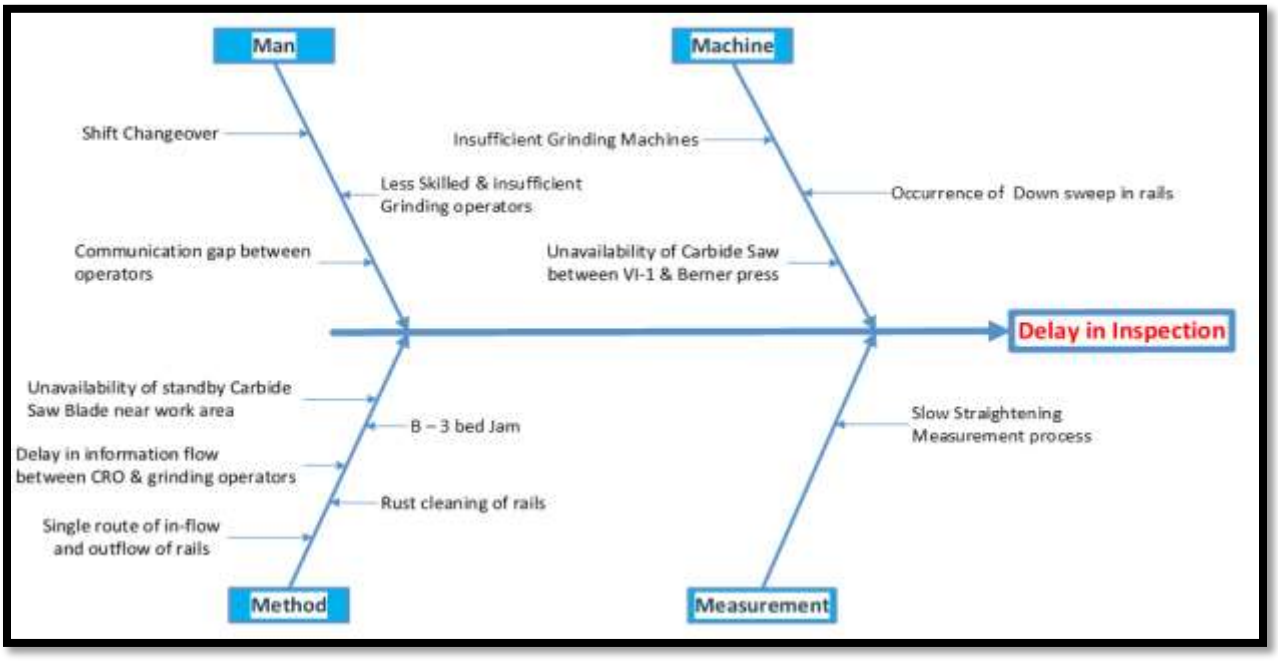

Fig. Fishbone Diagram to show main causes of delays

ABC Analysis :

So the next purpose of the analysis was to sort out various delays, so as to identify the most dominating delays out of an available source of delays.

CODE	Delay	Time (in mins)	% Contribution	Cumulative %
D1	Miscellaneous Delays	139	18%	18.1%
D2	Shift Changeover	132	17%	35.3%
D3	Due to measurement and marking	114	15%	50.1%
D4	Collection Bed B3 jam	85	11%	61.2%
D5	Communication delay between CRO and Cutting Operator	84	11%	72.1%
D6	Breakdown	69	9%	81.1%
D7	Communication delay between CRO and Grinder	48	6%	87.4%
D8	Blade Changeover	34	4%	91.8%
D9	Rail Shifting	29	4%	95.6%
D10	Communication delay between CRO and Press Operator	24	3%	98.7%
D11	Communication delay between CRO and Crane Operator	10	1%	100.0%
Total		**768**	**100%**	

Table. Percentage contribution of delays

For this, ABC Analysis was performed. The plots have been shown for each delay against the fraction of total identified delays for each agency. The data in the table shown above have been sorted on decreasing delays in minutes. And based on this table the graph is plotted.

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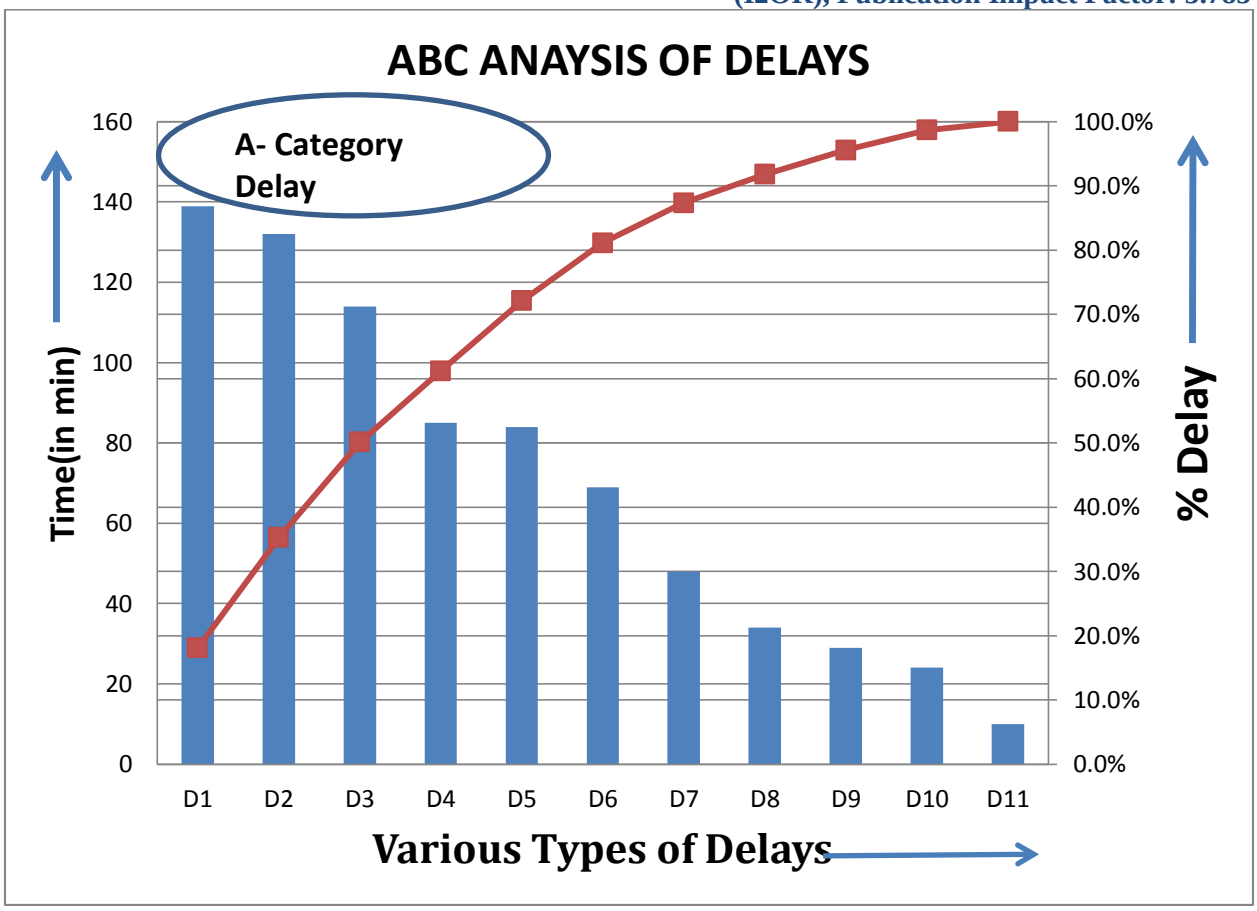

Fig. ABC analysis of delays

With the help of ABC- Analysis, it clearly shows that the major contributions of delays coming under Category-A i.e. 70% of the total delays, which are the main obstacles in the low production in Inspection line of a mill. The major contributors coming under A- Category are shift changeover, due to measurement and marking, collection bed B3 jam, communication delay between CRO and cutting operator & miscellaneous delays like housekeeping, grinding operations, etc. which causes interference in the process.

CONCLUSION

As it was expected to come up with a few solutions that can be immediately implemented so as to increase the production level, some ways to reduce the delays have been provided below.
After identification of all delays and bottlenecks, some suggestion to improve production was summerized below,

- The delay due to Length Measurement of rail by installing of new rail length measuring system to be cross-checked.
- The delay due to Shift Changeover can be minimized by using the concept of Hot-seat Exchange to be followed to reduce delays/ time loss due to Shift-changeover.
- The delay due to Rust cleaning of rails can be done in offline condition.
- The delay due to an additional too & fro rail movement for cutting operation can be resolved by the installation of new cutting machine between visual inspection & straightening.
- The delay due to the improper communication gap between operators can be solved by proper communication process to be ensured to avoid communication delays.
- The Single route of inflow and outflow of rails can be solved by developing a new alternate route for Inflow & Outflow of rail.

- The delay due to shifting of Grinding Machine to require position near rail can be solved by grinding machine may be mounted on suitably fabricated/ designed frame above the rail line.

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