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SYSTEM STUDY TO INCREASE THE OVERALL DISPATCH FROM ROLLING MILL

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Abstract - *Every manufacturing company wants to improve their operating system in order to survive the industry competition. In manufacturing organizations, to improve their system it might mean to reduce the operating costs that come from the wastes in production line or increasing the productivity in the finishing line. In most of the cases the latter scenario is put to use. However there are consequences of such an option. In order to increase the production, one must also need of extra resources for the additional activities associated with production such as dispatch. This report is an example of such scenario, where one needs to maximize the use of existing resources in order to increase the dispatch of increased production of finished goods through road and rail from Rolling Mill. Initially the rolling mill was producing certain quantity of finished goods and there were enough resources to dispatch the produced finished goods to its customers. Now the demand for finished products increased, and in order to compensate the demand, the production of finished goods increased, and there were more quantity of finished goods left to be dispatched to its customers. Therefore the problem was in the dispatch area, where an increase quantity of finished goods was available to be dispatched, but the existing resources were limited. So the objective of our project is to increase the dispatch of finished goods through road and rail from Rolling Mill using limited resources.*

Key Words: Production, Dispatch, Resources, Finished goods, Activities.

1. INTRODUCTION

In a steel manufacturing company, everything is planned, every layout is designed, and almost everything works according to the ones' expectation, but this system rattles when anything goes out of balance. The whole system shakes when the demand for certain product rises above a certain level, especially when the increasing demand needs to be fulfilled with the same limited resources.

The Rolling Mill currently faced a similar situation where it needed to meet the increasing demand using the same level of resources. Previously the rolling mill was producing a certain amount of products such as discrete plates, cut-to-length plates and coils, and was using it resources to dispatch the amount of goods it produced. As the scenario changed the demand for certain products increased, so in order to meet the increasing demands the production also increased, but what was limited is the resources it uses to dispatch those products to its customers.

So the problem arises in the rolling mill to increase the level of dispatch of finished goods to its customers using the same amount of resources. The rolling mill needed to dispatch a much higher quantity of finished goods using the same level of resources it used to dispatch a much lower quantity of finished goods. The only question was how can the same amount of resources be used to dispatch a much higher level of finished goods, and that's the objective of this project i.e., to increase the dispatch of finished goods though road and through rake.

In this report the existing "as-is" process of plate mill is studied, through which a detailed plant layout, process flow chart of various processes is made, which is then followed by data collection and analysis through which we were able to calculate the turnaround time and identify the delay and bottlenecks in the process, upon which various tools & techniques such as pareto analysis and cause & effect diagrams to identify the possible reasons of the delay and suggest feasible solutions.

1.1 Genesis of the problem

The purpose behind this project was to correct the following

- The demand of products were rising, so in order to meet the rising demand, production various products (such as Cut-to-length plates, coils, discrete plates) was increased
- As the production level increased, the dispatch of the finished products should also increase but the constraint was that the resources were the same, the resources were not increased to meet the increase in dispatch of finished goods
- Using the same resources, we now had to dispatch a much higher level of finished goods
- The dispatch of finished goods had to be increase to meet the increasing demands.
- The space was occupied due to the built-up inventory
- Improper stacking of various finished goods due to lack of space

1.2 Objective to be addressed

The objective of this report is to increase the finished goods dispatch through rake and through road

2. RESEARCH METHODOLOGY

In this project, we initiated our work by studying the current system or the "as-is" process with the help of which we were able to map out the layout of the plant, identify the current steps and procedure while carrying out a process, cycle time of various activities, identify no of persons employed in carrying out a process. After studying the "as-is" process of the system, we were able to draw the process flow chart of different activities employed in the system.

The next step was data collection. Past dispatch data of 12-14 months was collected, the current production and dispatch data was gathered and various on-field observations were recorded. The on-field observations were time-study of various activities performed in the system, in order to know the standard time taken by a worker to perform a given set of task or activities. Through on-field observations we also came to know about the various activities involved in a process, a complete work-breakdown structure of a process.

Data collection is followed by data analysis. The collected data is analyzed using various tools and techniques such as pareto charts, bar graphs, cumulative charts etc. All the collected data of past 12-14 months is analyzed and conclusions were drawn. From the analysis various time delays and turn-around time is calculated. Delays and bottlenecks were identified and the cause and effect diagram of the process is made. Standard time of different processes is calculated from the analysis of the data collected.

Industrial engineering tools & techniques were used to identify the problems in the system such as face to face interaction, interview of the workers for information, time study of different processes, utilization of different workers employed in different set of activities, process flow charts of different process were made, the layout of the plant and equipment was made, employee involvement, time study and work sampling etc. Using above tools and techniques various conclusions were drawn such as the reasons of the delays, cause and effect diagram of the system was made.

Finally different recommendations were made which were in the scope of improvement and which were economically and technically feasible. These suggestions were recommended to the department and their feedback were recorded and validated with the recommendations. The various suggestions were monitored and evaluated on the feedbacks received from the department.

3. DATA COLLECTION & ANALYSIS

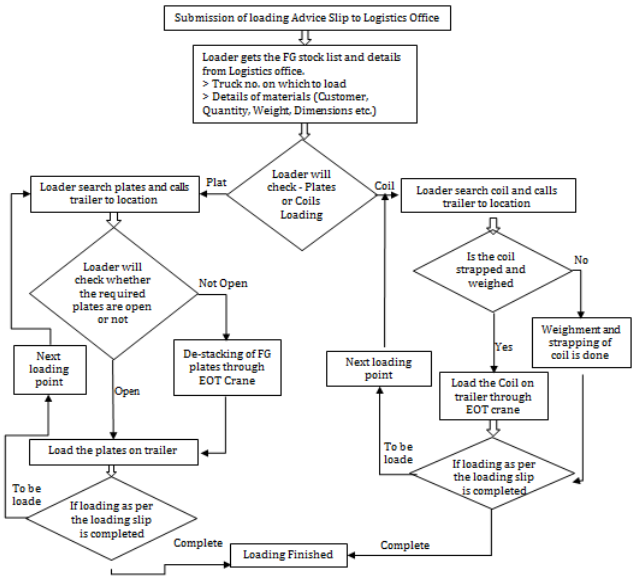


Chart -1: Process Flow Diagram- Road Dispatch

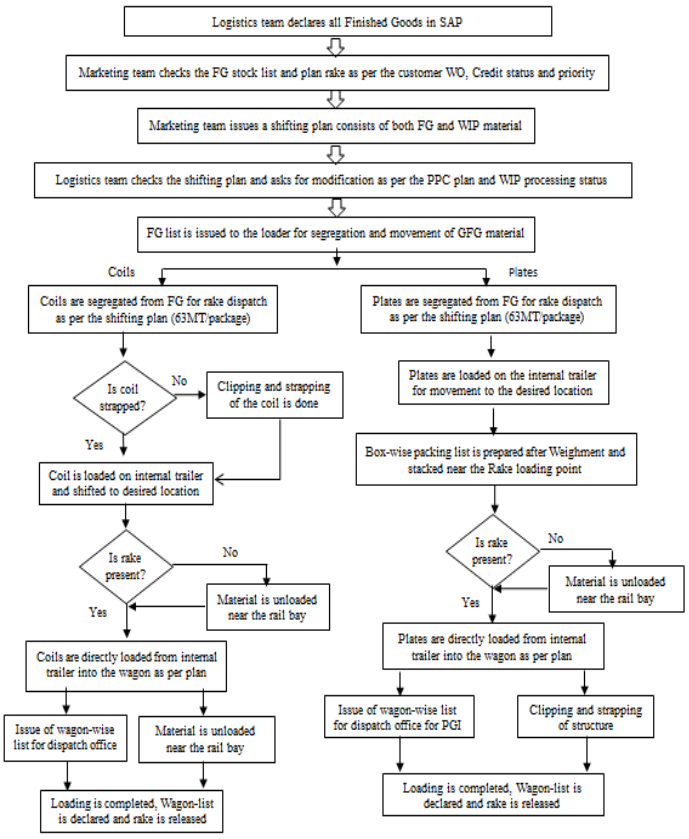
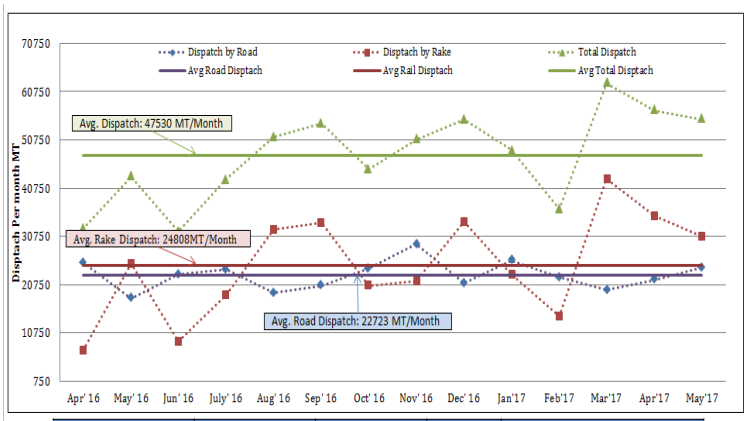


Chart -2: Process Flow Diagram- Rail Dispatch



	Avg. MT/Month (Apr' 16- May'17)	Max Dispatch (MT)	Max (Ton Per Day)	Remark (As per trends)
Dispatch by Road	22723	29234 (Nov'16)	974	Dispatch rate by Road has less variability
Dispatch by Rake	24808	42694 (Mar'17)	1377	Dispatch Rate of Rake has more variability
Total Dispatch	47590	62466 (Mar'17)	2015	

Chart -3: Monthly Production & Monthly Dispatch for Rolling Mill (Apr'16-May'17)

WIP Detail	No of days	Finish – Discrete Plates			
		Tonne	Pcs	pcs/day	Tonns /day
Feb	28	17142	3551	127	612
March	31	11947	2340	75	385
April	24	15113	3086	129	630
Total	*83*	*44202*	*8977*	*108*	*533*

WIP Detail	No of days	Finish – CTL Plate			
		Tonne	Pcs	pcs/day	Tonns /day
Feb	28	3549	2330	83	127
March	31	7202	5104	165	232
April	24	3473	2786	116	145
Total	*83*	*14224*	*10220*	*123*	*171*

WIP Detail	No of days	Finish – Rework			
		Tonne	Pcs	pcs/day	Tonns /day
Feb	28	95	117	4	3
March	31	3544	2760	89	114
April	24	11	15	1	0
Total	*83*	*3650*	*2892*	*35*	*44*

WIP Detail	No of days	Finish – Total			
		Tonne	Pcs	pcs/day	Tonns /day
Feb	28	20786	5998	214	742
March	31	22693	10204	329	732
April	24	18597	5887	245	775
Total	*83*	*62076*	*22089*	*266*	*748*

Table -1: Collection of Past Data

SN	Activity	Activity Code	Resources	Activity time (mins)
1	Shifting of material from Stack to Inspection area	A1	Crane + Supervisor	1.4
2	Visual Inspection (top surface and edge)	A2	Quality Inspector	1.3
3	Shifting of plate from WIP area to bottom stand for inspection	A3	Crane + Supervisor	2.2
4	Visual Inspection (bottom surface and edge)	A4	Quality Inspector	1.2
5	Shifting of plates from bottom stand to WIP inspction area	A5	Crane + Supervisor	2.4
6	Finishing Process (Dimension checking, Length, width and thickness)	A6	Quality Ins+ logistics person	3.2
7	Stenciling and painting as per customer	A7	logistics person	2.5
8	Shifting of plate from WIP to FG area	A8	Crane + Supervisor	2.9
9	Grinding	A9	Grinder	6
10	Gas cutting	A10	Gas cutter	6.5

Table -2: Activity Timings As Is Process

SN	Activity Code	Resources	Activity time (mins)	Crane-1	Crane-2	Quality Inspector-1	Quality Inspector-2	Logistics-1	Logistics-2	Logistics-3	Logistics-4
1	A1	Crane + Supervisor	1.4	1				1			
2	A2	Quality Inspector	1.3				1				
3	A3	Crane + Supervisor	2.2		1	1			1		
4	A4	Quality Inspector	1.2		1	1			1		
5	A5	Crane + Supervisor	2.4		1	1			1		
6	A6	Quality Ins+ logistics person	3.2				1			1	
7	A7	logistics person	2.5							1	
8	A8	Crane + Supervisor	2.9	1				1			
9	A9	Grinder	6								1
		Cycle time per plate		*4.2*	*5.7*	*5.7*	*4.5*	*4.2*	*5.7*	*5.7*	*4.0*

Table -3: Cycle Time per plate in case of CTL plates

SN	Activity Code	Resources	Activity time (mins)	Crane-1	Crane-2	Quality Inspector-1	Quality Inspector-2	Logistics-1	Logistics-2	Logistics-3	Logistics-4
1	A1	Crane + Supervisor	1.4	1				1			
2	A2	Quality Inspector	1.3				1				
3	A3	Crane + Supervisor	2.2		1	1			1		
4	A4	Quality Inspector	1.2		1	1			1		
5	A5	Crane + Supervisor	2.4		1	1			1		
6	A6	Quality Ins+ logistics person	3.2				1			1	
7	A7	logistics person	2.5								
8	A8	Crane + Supervisor	2.9	1				1			
9	A10	Gas cutter	6.5								1
		Cycle time per plate		*4.2*	*5.7*	*5.7*	*4.5*	*4.2*	*5.7*	*3.2*	*4.3*

Table -4: Cycle Time per plate in case of discrete plates

Description	CTL	Discrete Plates	Product Mix (From past data)	Remarks
Cycle time per plate (min)	5.7	5.7	6.13	Considering activity timing which is maximum
Total time available (min)	1260	1260	1260	Considering 21 hour working
Number of plates (EF Bay)	220	220	205	
Number of plates (AC Bay)	154	154	144	Considering 70% output from the EF bay
Total number of plates	374	374	349	Potential Output

Table -5: Potential Output

3.1 Finished goods dispatch through road

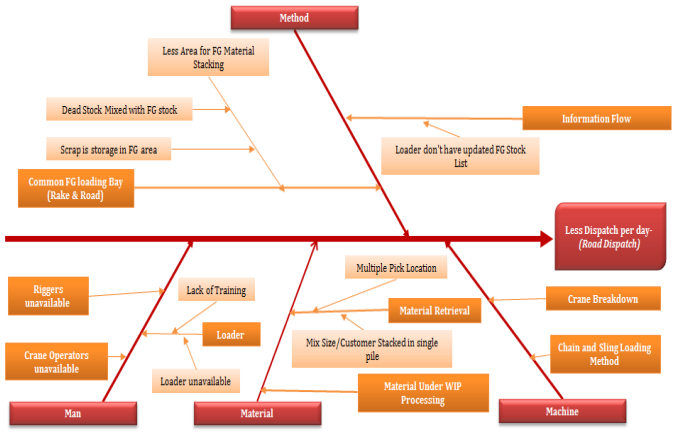


Fig -1: Fishbone Diagram- Delay in Road Dispatch

Avg. Loading Cycle time/Truck (incl. delays) - **213 min./Vehicle**				
Activities	Max. Time (mins)	Min. Time (mins)	Avg. Time (mins)	VA/NVA/ EVA
Issue of Loading Slip	41	20	30	EVA
Identification of FG in Stock list	25	0	8	EVA
Positioning of vehicle at loading point	20	8	14	EVA
Lack of Instruction	15	0	6	NVA
Unavailability of Loader/Rigger	47	0	14	NVA
Bay Engagement due to another truck	10	0	7	NVA
Crane unavailability	42	0	20	NVA
Searching of misplaced FG	65	0	16	NVA
De-stacking of Material	58	15	36	EVA
Loading of Material	35	10	17	VA
Others	10	0	5	EVA
Weighment and PGI activity	60	20	40	EVA
Total Cycle Time			**213**	
Total Value Adding			17	8%
Total Enabling Value Adding			133	62%
Total Non Value Adding			63	30%

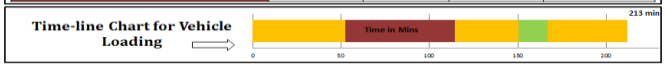


Table -6: Road Dispatch- Vehicle Loading Time Study

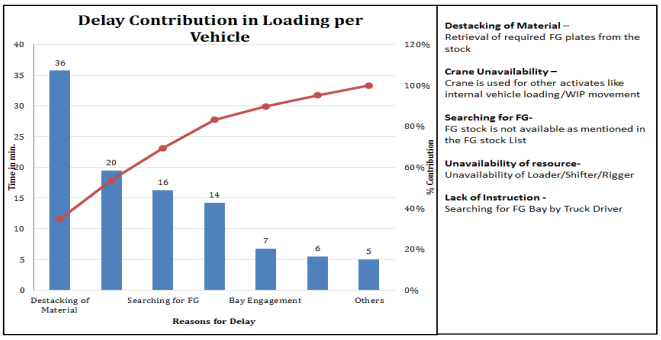
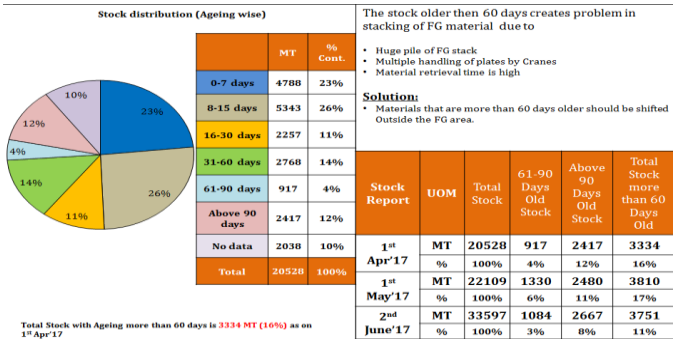


Chart -3: Pareto Chart of vehicle loading delay



	MT	% Cont.
0-7 days	4788	23%
8-15 days	5343	26%
16-30 days	2257	11%
31-60 days	2768	14%
61-90 days	917	4%
Above 90 days	2417	12%
No data	2038	10%
Total	20528	100%

Stock Report	UOM	Total Stock	61-90 Days Old Stock	Above 90 Days Old Stock	Total Stock more than 60 Days Old
1st Apr'17	MT	20528	917	2417	3334
	%	100%	4%	12%	16%
1st May'17	MT	22109	1330	2480	3810
	%	100%	6%	11%	17%
2nd June'17	MT	33597	1084	2667	3751
	%	100%	3%	8%	11%

Chart -4: Analysis- Ageing of finished goods on shop floor

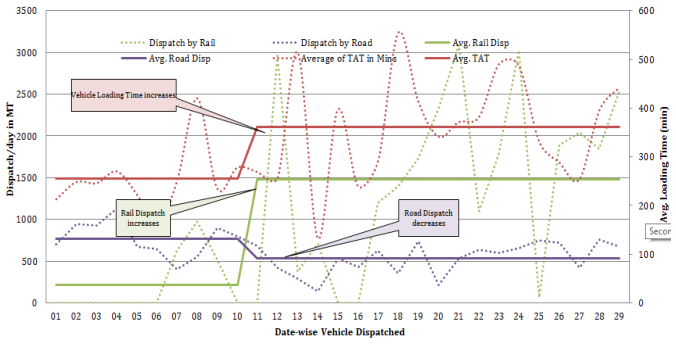


Chart -5: Analysis- Delay in loading time of the vehicle

Issues	*Current practices*	*Recommendation*
Less space for stacking FG	• Plates ageing more than 60 days are stacked in the FG area	• Materials that are more than 60 days older should be shifted Outside the FG area
FG area is not utilized effectively	• Huge pile of scrap is stored in the FG loading area	• Scrap from FG area should be evacuated at the earliest to use the space more effectively
Loading time per trailer is very high	• Road & Rake dispatch FG are **mixed and stacked in common FG area**	• **Dedicated FG area** for Road dispatch along with resources may be allotted for loading
De-stacking time is very high	• Generally huge quantity of mixed FG are stacked in individual pile	• Huge stacking of FG stock in each pile should be avoided
Delay in searching of FG material	• Each FG location is handled by various loaders	• Each FG locations should have loader who will be responsible for FG segregation and loading of the vehicle and maintain related data
Loaders do not have updated FG stock list	• Loader has to visit the Logistic office for FG stock list	• Updated FG stock list should be made available to the loader Or Online FG stock list may be available on TAB
Crane Unavailability	• Man not available during shift changeover and lunch	• Hot seat exchange should be practiced during shift changeover • Time loss during lunch should be minimum • Crane Breakdowns to be reduced by regular preventive maintenance

Table -7: Overall scope of Improvement for Road Dispatch

3.2 Finished goods dispatch through rail

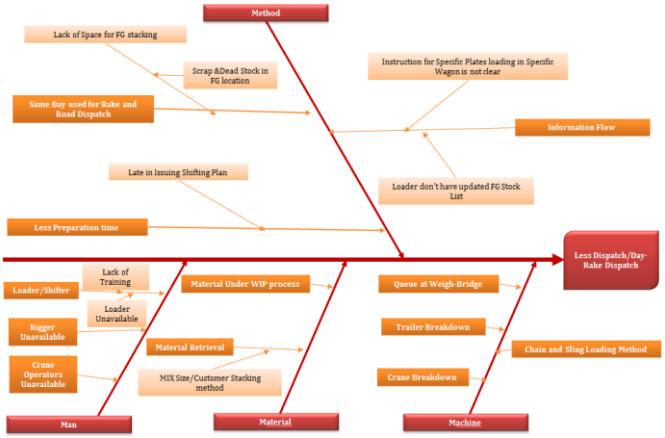


Fig -2: Fishbone Diagram- Delay in Rail Dispatch

Dispatch Details for Rake Dispatch from Rolling Mill (Mar'17 & Apr'17) Source: Rake-In Rake-Out Log Book						
	1-10 Mar	1-10 Apr	11-20 Mar	11-20 Apr	21-31 Mar	21-30 Apr
Total MT	9135	4851	8568	13797	25200	16191
Avg. Loading Time per rake (hh:mm)	20:00	30:00	12:00	18:00	20:50	27:00
Avg. Preparation Time per rake (hh:mm)	39:00	48:00	64:00	30:00	38:00	30:00
Nos. of Rake	4	2	6	8	12	8
Avg. Wagon/Rake	37	38	23	27	33	32
Avg. Loading Time/Wagon (hh:mm)	0:33	0:47	0:44	0:40	0:41	0:48

Analysis

- Avg. Loading time per Wagon is around 45 min./Wagon
- 80% of the cases the preparation time i.e. time between receiving of shifting plan from marketing and actual positioning of rake is more than 24 hours

FG material Dispatch through Rake consist of following activities:

1. Segregation of FG to be dispatched, Weighment and its stacking in the Rack Loading point (During Preparation Time)
2. Loading of FG in the Wagons as per the Wagon-wise loading list (After rake-In)

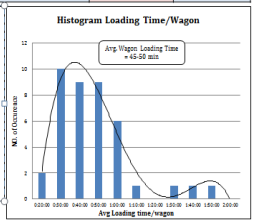


Table -8: Current Trends-Rake Dispatch

Rake Loading Observation was conducted for 2 rake

Rake 1: Partial Material is under WIP and full shifting of material at loading point is not done in advance
Rake 2: 100% material to be loaded is shifted at loading point in advance

	No. of Wagons			Material Status		Time (hh:mm)		
						Loading Bay	Loading time (incl. delay)	Delays
Rake 1	Coil	Plates	Total	FG	WIP	A Bay	21:00	5:10
	16	21	37	80%	20%	B Bay	33:00	18:00
Rake 2	Coil	Plates	Total	FG	WIP	C Bay	24:30	11:41
	2	38	40	100%	0%	D Bay	23:00	11:54

Observation for Delay
Rake1:
1. Delay in Rake loading was due to waiting for FG shifting through internal Trailor to Rake Loading area.
2. Waiting for WIP plates which was under processing

Rake 2:
1. Delay due to re-shifting of Material from One Bay to another bay as specific plates were to be loaded in specific Wagons type
2. Time loss during Shift Changeover

Corrective action for Rolling Mill Rake Dispatch

- As soon as the Rake arrives, **note the position of Open/Closed wagons** and then finalize the Wagon-wise loading list so that specific plates/coil would be loaded to suitable type of wagons.
- FG to be dispatched through Rake should be almost **100% ready** when the Rake is in. If not; remaining material under WIP process **to be given high priority** for finishing & shifting.

Table -9: Observation of Rake Loading

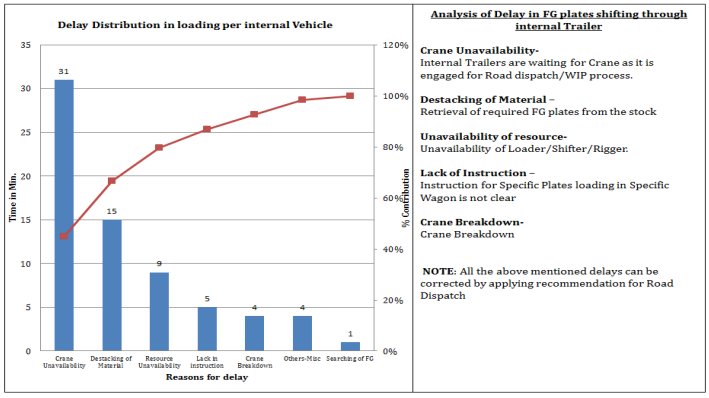


Chart -6: Pareto Chart of rail loading delay

Issues	Current Practices	Recommended Practices
Late Issue of Shifting Plan by Marketing Team	• In 20% case Shifting plan is issued in less than 24 hours time before rake placement	• 100% Rake shifting plan should be issued 24 hours before placing of rake-In
Preparation time for FG material shifting is not utilized properly	• Shifting of FG plates starts only 8-10 Hrs. before the placement of Rake	• Shifting of Material should start immediately after receiving Shifting Plan
No information about Wagon sequence before rake placement	• Wagon Sequence is noted only after Rake is placed in plate mill	• For better planning, Wagon Sequence information should be provided by the Central Logistic before rake placement
Crane Unavailability	• Man not available during shift changeover and lunch	• Hot seat exchange should be practiced during shift changeover • Time loss during lunch should be minimum • Crane Breakdowns to be reduced by regular preventive maintenance
Misc. Recommendations for Rake and Road Dispatch	• Layout Modification with FG-1, FG-2 and FG-4 location only for Road Dispatch. • Separate FG material stacking location for Rake and Road Dispatch • WIP and CTL processed material should be separately stacked and moved to the respective area as per the dispatch	

Table -10: Scope of Improvement for Rake Dispatch

S# No	Resource/Utility	Current (Upto 60,000 MT/Month)		Recommendation (Upto 75,000 MT/month)	
1	Gang per shift(1 Loader+ 2 Rigger)	6		8	
2	Loader per shift for Coil dispatch	1		1	
3	Utilities	10 EOT Cranes + 2 Trailers		10 EOT Cranes + 4 Trailers	
4	Additional requirement (Gangs + Utilities)	3 Trailer + 3 Gang		-	
5	Total Dispatch Points	8 Common Dispatch Point		3 Dedicated Road Dispatch Point- FG-1, FG-2, FG-4 5 Common Rake and Road Dispatch point	
Road Dispatch					
FG Dispatch Location		**(Upto 25,000 MT/Month)**		**(Upto 30,000 MT/Month)**	
	FG-1	1 EOT Crane	1 Gang	1 EOT Crane	1 Gang
	FG-2	3 EOT Crane	1 Gang	3 EOT Crane	2 Gang
	FG-3				
	FG-4	5 EOT Crane	2 Gangs	5 EOT Crane	3 Gangs
	FG-5				
	FG-7				
	FG-8				
	FG-6 (for Coil Dispatch)	1 EOT Crane	1 Loader	1 EOT Crane	1 Loader
Rake Dispatch					
FG Dispatch Location		**(Upto 35,000 MT/Month)**		**(Upto 45,000 MT/Month)**	
	FG-3	2 EOT Crane	2 Gangs	2 EOT Crane	2 Gangs
	FG-7	2 EOT Crane		2 EOT Crane	
	Additional Requirement (Gangs+ Utilities)	Traller + Gang are increased at month-end		Gangs can be shared from the Road Loading area	

Table -11: Recommended Resources for Road & Rake Dispatch

Photographs	Problems
	Huge Stacking Piles causes delay in searching and movement
	No Material Segregation
	Scrap in WIP and FG area

Table -11: Analysis- Delay due to Shop Floor Practices

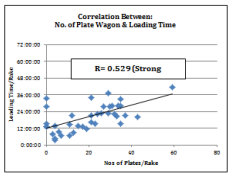
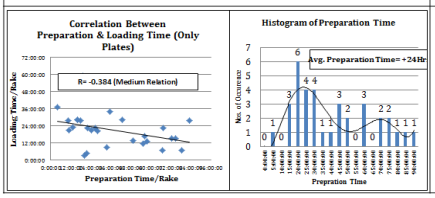
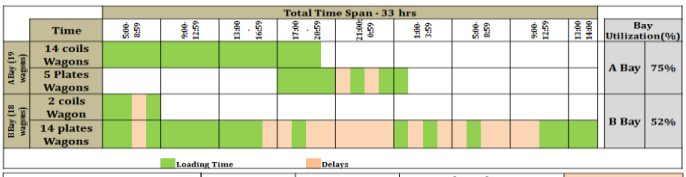
Statistical Interference	On Field Observation
	1. Loading time/Rake increases as the no. of Plates to be loaded increases • Plates Loading take more time as loading with Chain and Sling is a very slow process • While loading plates in Closed box Wagon the loading speed decreases further
	2. Rake IN and Rake Out (Loading Time) Time also depend on the Preparation time available before Rake In. • During this preparation time all material is stacked and made available at the Rake Loading Bay for dispatch before Rake is placed

Table -12: Analysis- Rake in-Rake out Time

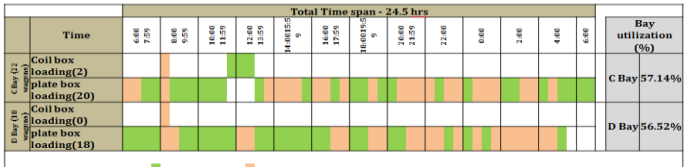


- No of Wagons- **37 Wagons**
- No. of Plates Wagons- 19 Wagons
- No. of Coil Wagons- 16 Wagons
- Total Loading Time- **33 Hrs**.
- Total FG planned - 2512 MT
- WIP Status- 307 MT
- Material Stacked before Rake-In time- 6 Wagons

Here the Rake was planned **20% WIP** which added to **7 hrs. delay** in loading time.
Apart from this there is **huge delay in material shifting by trailors.**

	Total Box	Actual Loading Time (hh:mm)	Delay (hh:mm)
A Bay	19	21:00	5:10
B Bay	18	33:00	18:00
Reasons for Delay			
A Bay		**B Bay**	
Waiting Time for Trailors	2Hrs	Waiting Time for Trailors.	7:57Hrs
Delay as material was in WIP	-	Delay as material was in WIP	7Hrs
Crane/bay Unavailability	0:22Hrs	Crane/bay Unavailability	0:15Hrs
Due to unavailability of manpower (Lunch/Shift Change)	1:54Hrs	Due to unavailability of manpower (Lunch/Shift Change)	2:51Hrs

Table -13: Rake-1 Loading Observation



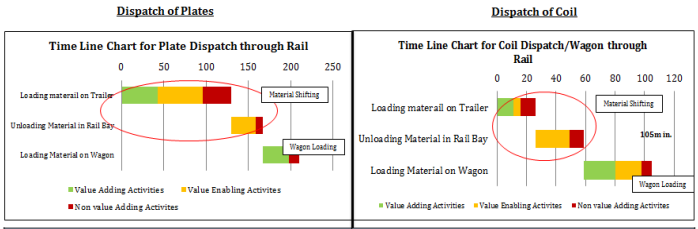
- No of Wagons- **40 Wagons**
- No. of Plates Wagons- 38 Wagons
- No. of Coil Wagons- 2 Wagons
- Total Loading Time- **24 Hrs**.
- Total FG planned - 2600 MT
- WIP Status- 0 MT
- Material Stacked before Rake-In time- 40 Wagons

Here the Rake was planned **0% WIP.**

However 5 Wagons material was interchanged, 2 Wagons material (Size constraints) was loaded in wrong Wagons and hence was unloaded and reloaded again

	Total Box	Total Actual Loading Time (hh:mm)	Delay (hh:mm)
C Bay	22	24:30	11:41
D Bay	18	23:00	11:54
Reasons for Delay			
C Bay		**D Bay**	
Material shifting from one bay to another	7 Hrs.	Material shifting from one bay to another	6 Hrs.
Crane Unavailability	3 Hrs.	Crane Unavailability	1 Hrs.
Waiting for instructions	1 Hrs.	Waiting for instructions	0.5Hrs.
Shift change	1 Hrs.	Shift change	1.5Hrs.
Unavailability of Riggers/loader	-	Unavailability of Riggers/loader	0.5Hrs.
unloading of loaded wagon	-	Unloading of loaded wagon	1.5Hrs

Table -14: Rake-2 Loading Observation



Material Loading Cycle for Plates Dispatch per Wagon- **210 min/Wagon**

Activities (Description)	VA	EVA	NVA	Total
Loading material on Trailer	43	53	34	130
Unloading Material in Rail Bay	0	29	8	37
Loading Material on Wagon	31	18 (Parallel)	12	43

Note: The above observation is Avg. of 10 samples observed from the field. Parallel activities are the Clipping and strapping of loaded plates

Material Loading Cycle for Coils Dispatch per Wagon- **105 min/Wagon**

Activities (Description)	VA	EVA	NVA	Total
Loading material on Trailer	11	5	10	26
Unloading Material in Rail Bay	0	23	10	33
Loading Material on Wagon	21	39 (Parallel)	7	46

Note: The above observation is Avg. of 5 samples observed from the field. Parallel activities are the Welding and strapping of support structure

Table -15: Rake Dispatch- turnaround Time Study/Wagon

3. CONCLUSIONS

Sr. No	Finished Good Loading Area	Nos. of FG storing Cell, MT-capacity	Current Practices	Recommended Practices
1	FG -1	32 Cells, 3200 MT	Road and Rake Mixed FG Dispatch	Only Road Dispatch
2	FG-2	39 Cells, 3900 MT		Only Road Dispatch
3	FG-3	32 Cells, 3200 MT		No Change
4	FG-4	12 Cells, 1200 MT		Only Road Dispatch
6	FG-7	35 Cells, 3500 MT		No Change
7	FG-8	20 Cells, 2000 MT		No Change
8	FG-6	34 Cells Only Coils	Road and Rake Coil Dispatch	Road and Rake Coil Dispatch
Total		204 Cells, 20400 MT		

Table -16: Distribution of FG storage Capacity Rolling Mill Dispatch

Area of Improvement/ Suggestion	
Two cranes should be dedicated for the WIP	# one crane should be doing the bottom inspection # crane should be busy in shifting material to and from stock to WIP
Logistics person (6 men) for the grinding of the plates	# Grinders should be dedicated for grinding process # Separate manpower should be available for the finishing process, grinders should not be used for finishing process
Logistics person (6 men) for the gas cutting of the plates	# Gas cutting should be given priority # gas cutter may be used for the finishing process only if there in no plates for gas cutting

Table -17: Scope of Improvement

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