ProModel Simulation Helps Resolve Steel Plant RMUY (Raw Material Unloading Yard) Constraint Issues

MN Dastur

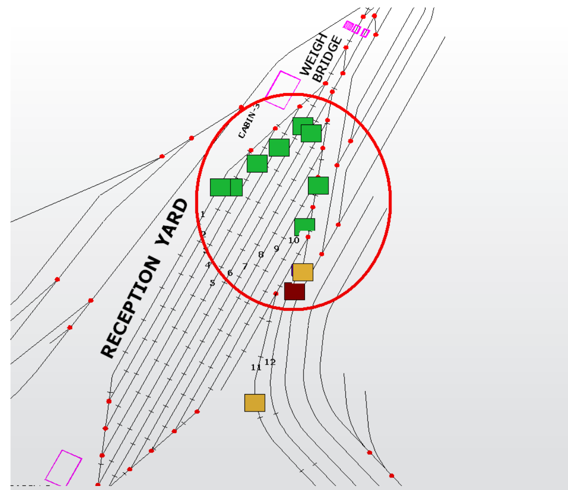
Success Story

Logistics

ProModel Optimization Suite

SITUATION

An integrated steel plant in India is planning an expansion of capacity by three million metric tons (MT). Major raw materials required for steel production are iron ore, coal, coke, limestone etc. These are received from various sources by the plant using railways in rakes. To unload the materials, the plant has a set of unloading equipment and railway locomotives. The locomotives move the rakes through the raw material routing network to unload the material across the material handling equipment which is then processed by the steel making units.



Congestion at the reception yard

With the expansion in production capacity, the inbound rakes for the raw materials are expected to increase, which might cause bottlenecks for the unloading facilities and constrain rake movements within the inbound material handling area. It is suspected that the current equipment and material handling network has excess capacity which might accommodate the increase of inbound raw materials. The adequacy of the number of plant locomotives and unloading capability of facilities needs to be thus determined. Additionally, the rakes for raw materials are provided by an external railways agency, having late charges for delays in the return of rakes beyond a certain time limit. The clock starts from the time the rake reaches the reception yard of the plant and ends on handing over the empty rake to the railway agency. It is also unknown whether the increased rake movement can create congestion in the material handling network leading to excessive turnaround times and hence increased late charges.

Given the complexity of the material handling network and its operation, a traditional analytical approach to determine capacity adequacy and congestion is too difficult.

OBJECTIVES

A simulation model was developed to understand the dynamics of the operation with the following objectives:

1. Evaluate the adequacy of current equipment capacities for the expansion by exploiting hidden capacities along with the modification in the route network.
2. Determine and validate the additional handling capacities if current capacity & operational policies are found inadequate.
3. Determine the congestion in the network due to the additional inputs in raw materials and the corresponding late charges.

RESULTS

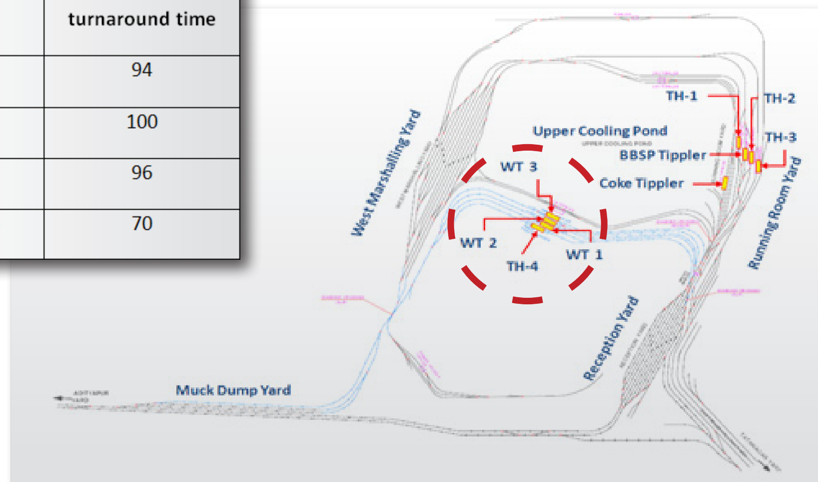
The model revealed that the existing system has some additional capacity for unloading, but not enough to accommodate the requirements for the entire 3 MT production capacity expansion. The primary reason for insufficiency in handling capacity was congestion of rakes in the route network.

www.promodel.com
1-888-900-3090 | saleshelp@promodel.com

After studying several solutions taking into account their immovable constraints such as no additional land available for laying more track, the following recommendations were made, which if implemented will allow them to handle up to an additional 4 million MT of steel production, while at the same time keeping rake turnaround times within the permissible limits for all the materials.

Additional material handling facilities were needed in order to reduce the traffic in running room yard, thus reducing congestion in the reception yard. 2 high-capacity coal tipplers, 1 iron ore track hopper and 1 limestone tippler, if placed in the network path moving away from the reception yard bypassing the running room yard as shown in Figure x would provide the required capacity. The existing coal tipplers and 1 limestone tippler were proposed to be discarded.

Material	% rakes within turnaround time
Iron ore	94
Coal	100
Coke	96
Limestone	70



For the rakes handled by the proposed equipment, the external railway engine would stay attached, while the material is being unloaded so that the rakes need not stop in the reception yard for handover and change of locomotives.

SOLUTION

Discrete event simulation modeling and analysis was used. The primary data required was for rake arrivals and for the processing lines at the material handling units. One year rake arrival data for the as-is system was collected. The data was fit into various distributions and best-fit distribution was selected with the help of Goodness of Fit tests in STAT-Fit utility of ProModel. The exercise was done for each raw material rake and separate distributions were framed for the source locations. The operation data, including the unloading rate of the equipment, planned maintenance downtimes, rake handling time components etc. were considered and an as-is model was built. The model was run and was validated with the current as-is system.

With satisfactory validation results, the new arrival distributions were framed using similar rake inter-arrival pattern, but with an increased number of rakes. To accommodate the unloading of extra material by the existing unloading equipment, it was decided to test modifications in the unloading operation and the route network. For iron ore fines rakes, being unloaded at 2 track hoppers, the external railway engine was kept attached to the rakes, while the material is being unloaded. The same rakes were planned to be taken out of the works using the reception yard instead of the west marshalling yard. This would reduce the processing time in the rail movement, while increasing the apparent capacity of the locomotives and reduce the locomotive traffic movement. The model was provided with the new arrival patterns to evaluate if there was any excess capacity in the current system which could be utilized to handle the additional material required for the expansion. The model was run for a period of one year and the results evaluated.

Material	Currently handled (MT)	Required after expansion (MT)	Unloading capacity with modification (MT)	Capacity delta (MT)
Iron ore	11.5	17.8	18.1	6.6 ↑
Coal	4.8	5.6	3.8	1 ↓
Coke	1.2	2.2	1.4	.2 ↑
Limestone	2.9	3.1	3	.1 ↑

Table 1: Material Unloaded

The model output as shown in Table 1 revealed that the existing system had some extra capacity for unloading, but not enough to accommodate the requirements for the entire 3 MT production capacity expansion. After incorporating the recommendations described in the results section the revised model indicated that not only could the Unloading Yard handle 3MT, but there was an additional 1MT of capacity available as well if needed for the future.