Optimizing Operational Strategies for Increased Throughput in a Manufacturing Plant

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About the Client

MARS is an American manufacturing corporation producing various food products, confectioneries and pet foods. They recently commissioned and operate a production plant in Hyderabad, India which produces a variety of popular pet care products such as Pedigree and Whiskas. This plant predominantly caters to the rapidly growing demand for pet products in the South Asian region. In order to address the increasing demand from one of their core markets, MARS embarked on a planned ramp-up of the plant capacity and approached Gyan Data to analyse the effect of this increase on the management of raw material and finished product handling sections.

Problem

MARS petcare manufacturing plant produces variety of pet care products in various stock keeping units (SKU) according to market needs. The plant has limited onsite storage space for stocking raw materials as well as finished products. Hence there is the practice of transfer of raw material from warehouse in trucks to the plant for production and corresponding transfer of packed products to warehouse from where it is shipped to global distributors. Apart from limited onsite storage, operational hours of both onsite storage and warehouses differ such that warehouses operate only during day hours whereas onsite storage works round the clock.



The problem was one in inventory management and planning, especially relating to the increase of throughput. The client recommended in depth understanding of their processes so that the effect of increased throughput on their practices in vogue could be clearly delineated. Specifically, they wanted to understand the effect of existing on-site storage space, rate of loading and unloading and usage of number of different types of trucks required for handling raw materials and also the finished products. The objective of the project was then to provide feasible recommendations to handle this planned increase in throughput.

Solution

Gyan Data approached the problem by modeling various operations involved in the raw material and finished product sections using a black box modeling approach. This approach was found suitable as this could replicate the existing practice followed in these sections and any experimentation could be tested using this model.

In the finished product section the powder based products were stored in silos of limited capacity before it was transferred to the packing section. There were more than one packing line operating in parallel, each capable of producing only specific SKUs. These packing lines were routinely stopped intermittently during change over and each line for each SKU was produced at different rates. Both the packing materials and packed products were stored in the same onsite storage space on pallets. There was restriction on amount of material to stack on each pallet and also restriction regarding mixing different SKUs, products and packing material rolls. Trucks of various capacities were used for transport and rate of loading/unloading differed with the number of available personnel. In addition to these, working time of onsite production was continuous round the clock, whereas warehouse worked only for 8 hour day shift. All the operations mentioned were model led as a black box model which was capable of estimating accumulation happening in silo and onsite storage for the given production schedule, packing schedule, rate of loading/unloading and number of trucks.

The black box model was implemented in MATLAB and validated for the existing throughput achieved in the plant. For the purpose of validation, two months of field data was collected and black box model was simulated which replicated the accumulation profile in silo and onsite storage for these two months. The accumulations profiles were found to be within the current limited space as expected. Then when throughput was increased keeping the existing rates and number of trucks, the accumulation started overflowing. Then an optimization problem was posed for the increased throughput containing constraints of silo and onsite storage space with number of trucks, loading and unloading rates as decision variables. This optimization problem was solved using NOMAD [1] available with OPTITool box [2], a free and open source tool box integrated with MATLAB. The result suggested a possible modification required interms of increase in onsite storage space, increase in number of trucks, rate of loading and unloading or various combination of these.

References

- [1] Nomad, a blackbox optimization software.
 - www.gerad.ca/nomad/Project/Home.html. Accessed: 2018-04-17.
- [2] Opti toolbox, a free matlab toolbox for optimization. www.inverseproblem.co.nz/OPTI. Accessed: 2018-04-17.

