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SIMULATION-BASED TOOL FOR INTERNAL LOGISTICS MANAGEMENT AT A LEADING TUBES SUPPLIER FOR THE ENERGY INDUSTRY

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ABSTRACT

A worldwide leading supplier of tubes for the energy industry was dealing with great challenges at managing the logistics at its production facility. The plant, located outside of Buenos Aires, has many production units related to each other with in/out material flows, carried out by two types of vehicles with trailers. Due to the highly dynamic environment, production plans have to be frequently updated and some processes used to show production stoppages as a result of an inappropriate assignment of logistic resources.

A tool based on simulation was developed and integrated to the planning and programming process to assist the logistic area in analyzing the allocation of resources along the next shifts and, at the same time, give feedback to the production programming area in case an adjustment on the plan is required to guarantee minimum waste of productive time on main processes.

INTRODUCTION

In this highly competitive context, the concepts of supply chain and maximization of the productive time for core processes are highly known within the industry. However, there are many companies where production and logistics operations are still neither planned nor executed in coordination. This was the case of a world-leading company, a supplier of pipes for energy and other industrial applications.

This company, instead of having an integrated process where the production program was a result of the consideration of both production and logistics restrictions and strategies, had defined a linear work flow process: the area of production programming defined a schedule considering production constraints and then the logistics area took this schedule as a fact trying to serve it in the best way possible. The consequence was a poor global result for the company due to interruptions at core processes, additional logistics costs and the inability to take advantage of idle resources (opportunity cost).

The company realized that an integration process was needed. This implied modifying the current working process and also implementing a tool capable of taking into account production and logistics restrictions at the same time for the entire facility and allowing an analysis for the next 30 days. Hence, a simulation model was developed, including processes like steel sourcing, hot rolling, heat treatment, threading, finishing and dispatch. These processes were linked by trucks and tractors, which were the responsible resources for moving WIP material from one center to the next one. Material handling inside production centers was also modeled: multiple cranes in charge of allocating material in warehouses and (un)loading production lines with the corresponding orders. The model, developed on AB and DE modeling paradigms, is capable of simulating the movement of each pipe and vehicle and evaluating the performance at each production line, integrating both production and logistics constraints.

SIMULATION-BASED SOLUTIONS

The main level of the simulation is formed by two general areas: logistics and production, each of them holding a lower level. These areas have the objects that best describe the system and it is where the decisions are made according to a set of logics developed specifically for the project. The information travels between these two areas in the form of a data package: an agent that contains all the attributes of the product (WIP). Tracking the material throughout the simulation became necessary both to validate and analyze the results.

The logistics object integrates the resources regarding WIP's movement. There are trucks and tractors responsible for moving the material, as well as trailers/semis where the product is put into to be moved. Each of the resources has the logics that determine how to pick the next movement whenever they are available. On the other hand, the production area is divided according to the layout. It has two types of agents: the ones that store the material in between processes (warehouses) and the ones that alter the product (production lines). There are two types of warehouses in the model. Two warehouses are developed in detail: every spot (rack) to store pipes is modeled, as well as the cranes in charge of the movements. The other warehouses are much simpler, modelling the whole area as a space capable of gathering a maximum of tons or units of pipes. The production lines are a set of discrete objects that represent the processes each product undergoes, with its waiting time and queues according to the production rate.

Both areas, logistics and production, are related by the WIP that moves from one line to another through the trucks or tractors. The information about each product moved is stored in the agent that works as a data package. Every time a truck or tractor leaves a product by a production line, the information travels from a logistic agent to a production agent. When a line needs either to receive a product to continue working or to have products removed from it, a request is made to the logistics brain, in the main level. A set of logics in the logistics area identifies the request and decides among the resources available, the pending requests and the different restrictions of the system. A decision must be made as to whether to move the WIP or wait for a better set of resources to choose from. Whenever a truck or tractor leaves material in a warehouse, it can be stored in different places depending on the next step the product will follow. The object that makes decisions inside a detailed warehouse is the crane. When a crane is available, it has to decide whether to move a set of pipes from/to the warehouse. It evaluates the state of the warehouse: empty spots, racks half full to be occupied, racks being loaded or unloaded by another crane, areas the other cranes are using, the best place to take these pipes in view of their route. Moreover, not every aspect has the same importance every time. Different circumstances make a situation more or less urgent, depending on the whole system. That is why the cranes incorporate a logic of dynamic priorities. These priorities may vary according to the system's status: the bottle necks are identified and the priorities shift. In each iteration, the cranes are evaluating the urgency of the requests, trying to solve those with greater need.

The information required to run the model determines the quality of the results. The model needs pieces of information from areas such as Production, Logistics and Supply Chain. The production program, productivity of each line, speed of each vehicle, amount of resources of each type, layout; all these are the minimum requirements to simulate the system. When running the model, the user can also choose among different scenarios and modify the default value of several variables. The restrictions of the facility are also added, such as: certain vehicles that can drive only in specific routes, or depending on the material and its destination, the trailer that can be used. There are particular lines that cannot stop their production (due to very high costs in doing so) and both vehicles and production lines work on an strict schedule, among others restrictions.

Being able to evaluate the system as a whole, taking into consideration the information of all the areas and the state of each vehicle, production line and set of pipes is what allows the model to make an integrated decision at every step. Its flexibility leads to a greater analysis of strategies' impact.

RESULTS AND BENEFITS

Nowadays, the tool is fully integrated into the managerial process, giving detailed information about the future logistics requirements and feedback to both production and logistics areas about the synergies opportunities. This is the first time in the history of organizations that production and logistics work fully communicated, allowing a clear and optimized decision-making process. Additionally, medium-term decisions, such as the quantity of resources to put out-of-service, have been taken based on the simulation results.