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A TOOL FOR ANALYZING PICKING OPERATIONS WITHIN A DISTRIBUTION CENTER

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ABSTRACT

This article presents an analysis tool for picking operations developed by DHL in Brazil and Simulate Tecnologia de Simulação, also in Brazil, using discrete-event simulation. The analysis tool provides information to the distribution center managers (the decision makers) that reduces the problems caused by variations in the volume of demand at DHL. The analysis tool predicts potential bottlenecks in the day-to-day operations of the shipping facility. This tool is in intensive use and is strongly endorsed by the firm.

EXTENDED ABSTRACT

A common problem within businesses is the lack of information and the uncertainty in operations caused by variations in demand. It would be very useful to have a tool that provides useful information about the future. Imagine having a “crystal ball" that keeps a manager informed about potential operational problems that might be expected. The tool also suggests pathways for material flow in terms of expected time and cost.

The OPUS Group (Optimization Processes Using Simulation), formed by employees of DHL, Louveira, Brazil (DHL Louveira) operations, (http://www.dhl.com/en.html) in conjunction with Simulate Tecnologia de Simulação, a Brazilian firm specializing in simulation, has developed a tool that anticipates the results of a working day in a distribution center and predicts problems that may arise. DHL Louveira, (located in the State of São Paulo, Brazil) consists of an area of approximately 138,000 m2 with a picking area of approximately 13,500 m2. This is a large operation in terms of both size and volume. On peak days, it is common to find short term bottleneck situations appearing in the operation. Therefore it was decided to build a simulation model to represent all picking operation, with the aim of having a tool that will improve productivity in the DHL Louveira picking area by forecasting the bottlenecks that occur because of resource requirements including pickers, manual carts and forklifts trucks.

Model development included model conceptualization / data collection, implementation and analysis. The following paragraphs explains briefly each phase.

Model conceptualization is an essential part of the overall simulation study during which the model’s purpose, its complexity, and the needed input and output data are determined. The overall picking process is always the same comprehending the following tasks: Receiving the picking list, transport to pick face, perform picking and go to the stage (area within the products are layered) if the picking list is finished. If it is not finished then go to another pick face, until the picking list Is complete. Although this process is

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simple there are several "complications." There are pickers with an automatic pallet cart and pickers with a manual pallet cart, that provides different performance. There are also different levels of expertise: there are novice pickers (called "new hires") and also experienced pickers (called "Synergy"). Since the system consists of almost 5,000 pick faces, it was decided to group 10 pick faces into one.
In this project model conceptualization generated a Word document that specified the model and all the data needed, so the next phase (data collection) despite the fact that it was time consuming was straight forward since the main model was designed. Some of the data uses distance to compute time and other data (such as pick time) was fed into statistical software (Stat:fit). But the main challenge of the project was to model the daily picking demand. This was done making a software routine that converts the data stored into WMS (warehouse management system) and generates a pick list (in fact the algorithm developed simulate the real generation of picking list), that will fed the simulation model.

The model was implemented into Simul8 Professional 2008 Simulation Software. The model was implemented aisle by aisle. After the implementation of some aisles, the model was run and validation tests were conducted to determine that the logic was working properly. When the simulation analysts trusted the model results, the model was expanded. This process was repeated until all 37 aisles and 468 locations were implemented (recall that each location represents 10 pick faces). In order to verify the model, other techniques were used such as visualization of model variables, the use of the debugger, and comparison of model results to manually computed results.

The main outputs of the model are utilization of each kind of picking resource, total distance traveled, productivity of resources in terms of the number of boxes picked per hour. The replenishment quantities were also provided (replenishment quantities measure the number of items that were replenished during the simulation). The model was configured to provide three basics managerial reports: Managerial Summary Report shows simulated productivity measure in boxes picked per hour at a specified demand (load profile), Resource Utilization Report that shows the utilizations hour-by-hour for each kind of picker and Proactive Replenishment Consolidates all the replenishment instances that occur during the day. With the hour-to-hour information report, the analyst responsible for the operation can perform several kinds of analyses.

After completing the computer model, it was validated operationally to assure that changes in the simulation model can be made and inferences can be drawn about the real system. This was accomplished by performing an input/output validation to compare the results of the model with actual output. After several iterations of black-box analysis, model results converged within a minimum of 2% difference and maximum of 8% difference from the actual hourly productivity. This was determined to be reasonable by DHL Louveira.

The model was then used to verify if a specified staffing level of pickers would be able to meet the daily demand. So the analysis was performed according the following: If the demand can be met with the planned staff levels, then the analysis is finished and this is passed to the picking operation (the model runs shortly before the operation starts each day). However, if the anticipated demand (picking volume) is high the picking may not be achieved with the planned staff levels for each area. In this case, the staff levels for each hour should be increased until the demand is met. If the staff levels are high, demand could be met, but picker utilization will be low. But if the demand is very high and there is no resource available to meet it, a negotiation with the customer takes place. But this is done before the starting of operation.

The initial question was, "Is it possible to create a tool that indicates what is expected to happen at DHL Louveira during the next time period?" A simulation model was developed to provide the requested response. The availability of this information has a major impact on the daily operations at DHL Louveira. Now, DHL Louveira is no longer "chasing" the problems, but rather DHL Louveira is operating proactively, providing solutions to enable keeping commitments and exceeding customer expectations. Furthermore comparing the months without the use of the tool and the months with the use of the tool, it was found an increase of 11% of picking productivity was one of several of its benefits. But, from the DHL Louveira point of view, the major benefit of the tool is the supply of assertive responses, avoiding decisions based on "operational feelings," i.e., "gut feelings" are a thing of the past.