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DIGITAL TWINS FOR PICKING PROCESSES - CASES DEVELOPED BY A BRAZILIAN CONSULTING COMPANY

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ABSTRACT

The "picking" process is a relatively common logistics process in distribution centers: according to the picking list, products are separated and packed in specific containers (usually boxes) where customer orders are consolidated. The vast majority of picking processes involve intensive use of labor. Due to the complexity of this process, simulation is an extremely suited tool for its correct performance evaluation. This article will depict some applications of digital twin simulations for picking processes in practical cases for daily picking operation evaluations.

1 INTRODUCTION

The picking process is a logistics sub-process (such as receiving, replenishment, etc.) within a distribution center where order picking actually takes place. Usually, operators (or "pickers") receive a picking list and walk around the warehouse looking to pick items, place them on a stage, and return to process the next item or picking list. There are other picking methodologies and automated picking technologies (i.e.: carrousel, picking conveyors, picking by light, picking by voice, etc.). Picking processes present great complexity, mainly due to their dynamic and random nature. For systems with such characteristics, Discrete-Event Simulation models are a highly suitable and advisable analysis tool: the simulation model seeks to repeat on a computer the same behavior that the system would present when subjected to the same boundary conditions being a Digital Twin. There is no absolute definition of the term "Digital Twin" in literature but as per the article by Chwif (2024), Digital Twins can be classified into 3 categories whereas a Discrete Event Simulation Model lies in Digital Twin - a common sense definition since it is a digital replica of the system.

2 DHL CASE

This model was developed in conjunction with DHL to simulate the daily picking process of their largest picking operation in Latin America. Due to its predictive characteristics, it was nicknamed "Crystal Ball". An algorithm was developed to replicate the picking list from the picking load from the Warehouse Management System, and then, at the beginning of each day, this was fed into the simulation model to check if the daily picking workload would be entirely processed with the available resources. If not, further resources would be added. If the daily picking workload cannot be attended on the same day, even with the addition of resources, a negotiation with the client should be made to postpone some orders.

Even though crude financial gains were not stated by DHL, several gains were observed within two years after the simulation daily use: an increase in productivity and a reduction in cases that were not separated daily due to lack of resources. DHL's relationship with the client was also improved since they know in advance if all the picking load can be delivered within the same day. It was shown that "Crystal Ball" provided an accuracy of 98% (2% deviation from reality) (see Simul8 (2024) for further references).

3 LUXXOTICA CASE

Technological advancement in the logistics area is undeniable, however, labor is still the biggest cost and the most complex variable in the management of a distribution center. Therefore, structuring a plan to predict the correct people allocation concerning the type and quantity of tasks while maintaining an efficient operation with low costs without compromising the level of service is extremely challenging. This case was implemented in Jundiaí, SP, in Luxottica distribution center, an Italian distributor, retailer, and the largest eyewear world manufacturer.

Among the tools capable of assisting in workforce dimensioning, Discret-Events Simulation has been widely used. Thus, a Digital Twin model was developed in Simul8 software to size the ideal number of people in the operation, especially in the picking, due to its complexity and intense use of labor. Eight input queues were defined for picking, according to the profile of the deliveries of the allocation portfolio, and for each of them, there is a distribution to simulate the randomness of productivity. The simulation model indicated operation bottlenecks, surplus or lack of resources, and idleness, which can be transformed into opportunities for synergy between the areas for resource optimization instead of materializing as operational inefficiencies.

Luxottica currently uses the simulation model not only to monitor the daily operation but also as a mean of monthly planning tool to guide future contracts when considering the volume forecast for the next 3 months. Therefore, in addition to signaling operational inefficiencies on a daily basis, the tool also reduces the amount of resources provided by eliminating the safety coefficient and rounding that Excel spreadsheets presented.

4 ZF CASE

ZF is a global technology company that provides high-end products and systems for automobile mobility, commercial vehicles, and industrial technology. In 2023, with around 168,700 employees worldwide, ZF achieved sales of 46.6 billion euros. The company is present in 162 production sites in 31 countries.

ZF's distribution center has a complex picking operation involving several demands and different handling and picking systems, which makes daily resource planning a non-trivial activity. The main objective of the development of ZF's Digital Twin model is to provide a tool for operational use that, based on the daily demand and resource allocation, gives a view of the main KPIs before the start of the operation to perform more efficiently and smoothly, thus minimizing the number of operational interventions during the day.

In the simulation model, layout data (position of each part number in the warehouse), demand data (daily demand), and resource data (number of resources hour-by-hour) entered in each picking area are fed. Several KPIs were evaluated to check if the daily demand is met with the resources fed into the model. If the resource levels are too high, the picking planner will lower the resource number; if the daily demand is not met, he must raise the resource level. Currently, we are working to automatize the resource level determination by developing a simulation optimization solution that will derive the optimum number of resources to fulfill the daily picking operation.

5 FINAL REMARKS

This work depicted, describing real industrial case studies, how important is to have a Digital Twin model for daily picking operations since the picking process is very complex and labor intensive. Only a simulation tool can truly evaluate the picking process performance, providing an accurate and precise environment for making operational decisions on picking processes.

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