IMPACTFUL SIMULATION MODELS FROM A BRAZILIAN SIMULATION CONSULTANCY

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ABSTRACT

Simulate Simulation Technology is a Brazilian consultancy company focused on developing discrete event simulation models and providing simulation training. Some of the simulation models developed over the last 20 years are classified by us as successful and impactful, with no relationship to their complexity, applicability level, or purpose. This article presents some of these models.

1   INTRODUCTION

In Simulate Simulation Technology, we have built more than 200 models over the last 20 years. Using mostly the Simul8 software, we created decision-making models for the most diverse areas, such as manufacturing, logistics, aerospace, port terminals, supply chains, etc. Some of these models had a remarkable impact in terms of financial or intangible gains for the clients, even being the subject of scientific and non-scientific papers (unfortunately, some of the actual financial gains can't be stated due to confidentiality reasons). Next, we present four models and explain why we consider them to be so impactful. We also categorize these models regarding complexity, applicability level, and purpose. In terms of complexity, we classified the models as simple or complex, according to the number of simulation objects/variables and their interactions. Regarding applicability level, we divided the models into strategic/tactical or operational: a strategic/tactical model helps to make point decisions (e.g. factory design), while an operational model runs within a certain time period, such as production scheduling models, to aid in picking resource decisions, for example. Finally, the purpose of a model can be to simulate a new system (new conception or project) or to propose improvements to an existing operation.

2   HEALTHCARE: VISUAL FIELD EXAMINATION MODEL

This model was developed *pro bono* for 'Escola Paulista de Medicina to optimize the process of attending the visual field examination, an important ophthalmological examination to help prevent vision diseases such as glaucoma. The sooner a problem is detected, the greater the chance of cure and the lower the patient's risk of losing sight. This model can be classified as a simple, tactical, and improvement model.

Why is it impactful? Through simulation, we showed that the field examination service capacity could be increased to serve 6 patients per shift instead of 5. This was possible at the expense of a small investment (changes in layout, operational procedure, and minor equipment acquisition). The variation may seem small, but it contributed a lot in reducing the examination queueing time, from 6 months to 1 month, allowing to preserve patient's vision if the treatment starts promptly.

3   PICKING LOGISTICS: "CRYSTAL BALL" MODEL

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 could not be attended in the same day, even with the addition of resources, a negotiation with the client should be made to postpone some orders. This model is classified as a complex, operational, and improvement model.

Why is it impactful? 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 picking load can be delivered within the same day. It was shown that "Crystal Ball" provided an accuracy of 98% (2% deviation from reality).

4 PASSENGER TRANSPORTATION: PRE-SALT SIZING MODEL

Usually, staff transportation to oil platforms is carried out via helicopter, however, this model sought to evaluate multi-modal transportation solutions for the pre-salt using an offshore hub and vessel, due to the high cost of the helicopter freight if used alone. That's because in pre-salt some platforms are more than 500 kilometers far from the shore. Given the complexity of this problem, involving dynamic and random aspects, discrete event simulation was the analysis tool chosen to evaluate different scenarios and scale the number of transportation resources across each scenario to guarantee that a minimum of 99% of the passengers were transported to and from the oil platform within the same day. This model was developed for Petrobras, one of the largest Brazilian public companies, in partnership with Sólido Engenharia, another consultancy company. We classify it as a complex, tactical, and new system model.

Why is it impactful? In addition to the operational performance measures, each transportation alternative cost was evaluated, supporting the choice of the best solution. The beauty of this model is that it effectively supported the decision of the best configuration. It is important to note that not only financial information was considered in the final decision but also the scenario that maximizes passenger safety.

5 MANUFACTURING: RETURNABLE PALLET ASSEMBLY LINE MODEL

This model was developed for a home appliance industry to evaluate an assembly line of returnable pallets for the oven cavity of the stove. The model was used to establish the minimum number of pallets in use to maximize the line productivity and also test some specific operational logic. Instead of a classic "O" shape returnable pallet assembly line, the assembly line shape resembles an "8", with a nonlinear flow. This model is classified as simple, tactical, and new system design.

Why is it impactful? With this model, we showed that, in manufacturing systems, the maxim "The more, the merrier" is not always valid. This model allowed to cut costs in pallets acquisition since they were initially over-dimensioned. Furthermore, it proved that the productivity target could be met even with an unconventional assembly line layout. In 2019, this model received an award from ABDI (Brazilian Association for Industrial Development).

6 FINAL REMARKS

We presented four impactful simulation models developed in Brazil, i.e., models that had a remarkable impact in terms of financial or even intangible gains for the clients. It's interesting to point out that this "impactfulness" property does not have any relation to complexity, applicability level, and purpose. For instance, even a simple model (with few simulation objects) can turn out to be impactful. Furthermore, besides the gains, all models presented helped somehow to enhance the decision-making process, which is the ultimate goal of a simulation model.

Further information about the four models cited in this article can be found, in Portuguese, at https://simulate.com.br/noticias_2022.html#Modelos.