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An innovative approach to integrate design of experiments in simulation

(Case study: optimal allocation of staff in a center for medical care)

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Abstract—An innovative approach to integrate design of experiments methodology in simulation of systems is presented in this paper. The proposed method can be used to evaluate and improve systems using simulation. The innovative method is designed in 5 phases and steps of each phase are determined in detail. In order to explain the steps of the innovative approach, a case study is carried out to optimally allocate staff in a center for medical care. Accordance with the innovative approach that is presented, the problem is designed, response variable and effective factors are identified and a 2^k factorial design is created. After simulating the center for medical care and verifying the created model, design of experiments is conducted on the simulated model of the system to determine the effects of the factors. Finally, using the innovative approach, strategies for improving the system are found and proposed to implement in the system.

Keywords—component; Design of experiments; Simulation; Factorial designs; Design of experiments in simulation; Search for optimal policy

I. INTRODUCTION

Systems simulation has long been used to find ways to improve the systems. Repeated trial-and-error process of systems to find optimal policies hurts people and systems and causes long-term inappropriate results. System simulation is a way to prevent systems from exposure to repeated trial-and-error process and gives managers a wider opportunity in order to design more extensive experiments on the system.

Generally, the proposed methodologies of simulation projects lack a special mechanism to design targeted experiments in simulation models. Usually, there has been an assumption in simulation projects that the kind of testing is completely the same and, after modeling, some

predefined experiments should be performed on models. Although most simulation projects get multiple outputs of the model to analyze various aspects of the experiment, but in the meantime, the absence of a holistic and targeted methodology is being felt to find the optimal policy in simulation models. Of course, the distinguishing feature of this paper can be found in the innovative methodology.

In the current paper, a holistic method is designed to search for optimal policies of the system in a simulation model using design of experiments. In the innovative approach, a step-by-step procedure is designed to implement its approach in addition to considering all the details of system optimization using integration of design of experiments in simulation. Finally, a case study is conducted in order to test the innovative approach. Case study is a clinic that has a heterogeneous allocation problem of employees in the whole departments.

Literature review is presented in the second section of the article. In the first part of the literature review, studies that used design of experiments in simulation are reviewed and, the differences and similarities between those studies and the current paper are discussed. In the second part, articles that have used simulation in healthcare are reviewed and a classification of them is presented. The third part of the paper provides details of steps for the innovative method. Section 4 to the end of the article explains a step-by-step implementation of the innovative approach in the case study.

II. LITERATURE REVIEW

A. History of Design of Experiments in Simulation

Reviewing articles in the field of simulation suggests that design of experiments in simulation has been used in recent studies due to multiple reasons. Although many