ABSTRACT

Puri, Vivek. Ph.D., Purdue University, December 2011. Incorporation of continuous activities into activity cycle diagram based discrete event simulation for construction operations. Major Professor: Dr. Julio C. Martinez

Construction operations have been modeled and simulated using Discrete-Event Simulation (DES) with effectiveness and fidelity that has continuously increased over the past four decades, since the introduction of CYCLONE. Today it is possible to model construction operations so that its discrete components are represented very faithfully. However, construction operations often include activities that are simultaneously continuous and stochastic in nature. These continuous activities have typically been modeled by discretization and in some cases using combined discrete-continuous simulation. Modeling by discretization brings along a series of important statistical issues related to the divisibility of fitted distributions and a significant possibility of the discretized activities not being Independent and Identically Distributed (IID). Combined discrete-continuous simulations have treated the continuous portion dynamically (i.e., based on differential equations of rate change) but either deterministically or disrespecting statistical properties of the underlying continuous stochastic process and its interactions with the discrete portion. Most of these issues can be attributed to either limitations of the modeling tool or assumptions by the modeler. These assumption and limitations can seriously affect the accuracy of the model in representing the system behavior, grossly impact the simulation results and can be detrimental to the acceptance of the model due to difficulties in verification and validation.

A clear understanding of the underlying problems is required when modeling simultaneously continuous and stochastic processes. This research study investigates the major issues associated with modeling continuous stochastic construction activities, highlights possible sources of error and develops a framework for a combined discrete and continuous approach that utilizes methods optimized for modeling and simulation of continuous construction activities within the three phase scanning algorithm of a discrete event simulator. The approach includes support for modeling dependence within the observed data, mixed modeling of discrete and continuous activities, discrete and continuous resource flows and other algorithms to improve the accuracy and efficiency of the modeling and simulation of continuous construction operations. As part of the study, these methods were implemented as an extension to STROBOSCOPE, a powerful discrete event simulation tool optimized for construction simulation.