
Part I

Fundamentals

Part I of this book establishes the foundations for the subsequent discussions about our topic of interest, namely, modelling and simulation. It consists of two chapters, namely, Chaps. 1 and 2.

In Chap. 1 we briefly consider a variety of topics that can be reasonably regarded as background material. A natural beginning is a brief look at a spectrum of reasons why a modelling and simulation study might be undertaken. Inasmuch as the notion of a model is fundamental to our discussions, some preliminary ideas that relate to this notion are presented. A generic ‘full-service’ gas station is used to illustrate some of the key ideas. We then acknowledge that modelling and simulation projects can fail and suggest a number of reasons why this might occur.

Monte Carlo simulation and simulators are two topics which fall within a broadly interpreted perspective of modelling and simulation. In the interests of completeness, both of these topics are briefly reviewed. We conclude Chap. 1 with a brief look at some of the historical roots of the modelling and simulation discipline.

Modelling and simulation is a multi-faceted, goal-oriented activity and each of the steps involved must be duly recognized and carefully carried out. Chapter 2 is concerned with outlining these steps and providing an appreciation for the modelling and simulation process. The discussion begins with an examination of the essential features of a dynamic model and with the abstraction process that is inherent in its construction. The basic element in this abstraction process is the introduction of variables. These provide the means for carrying out a meaningful dialog about the model and its behaviour properties which must necessarily be consistent with the goals of the study. Variables fall into three categories, namely, input variables, output variables and state variables. The distinctive features of each of these categories are outlined.

The modelling and simulation process gives rise to a number of artefacts, and these emerge in a natural way as the underlying process evolves. These various artefacts are outlined together with their inter-relationships. The credibility of the results flowing from a modelling and simulation project is clearly of fundamental importance. This gives rise to the topic of quality assurance and we conclude Part I of the book by exploring various facets of this important topic. In particular, we examine the central role of verification and validation as it relates to the phases of the modelling and simulation activity.