Decisions about Modeling and Simulation (M&S) of Complex Systems (CS) need to be evaluated prior to implementation. Discrete Event (DE), System Dynamics (SD), and Agent Based (AB) are three different M&S approaches widely applied to enhance decision-making of complex systems. However, single M&S approaches can face serious challenges in representing the overall multidimensional nature of CS and may result to the design of oversimplified models excluding important factors.

Conceptual frameworks are necessary to offer useful guidance for combining and/or integrating different M&S approaches. Although several hybrid M&S frameworks have been described and are currently deployed, there is limited guidance on when, why and how to combine and/or integrate DE, SD and AB approaches. The existing hybrid frameworks focus more on how to deal with specific problems rather than to provide a generic way of applicability to various problem situations.

The main aim of this research is to develop a generic framework for Multi-Method Modeling and Simulation of CS, which provides a practical guideline to integrated deployment or combination of DE, SD and AB M&S methods. The key contributions of this dissertation include: (1) a meta-analysis literature review that identifies criteria and generic types of interaction relationships that are served as a basis for the development of a multi-method modeling and simulation framework; (2) a methodology and a framework that guide the user through the development of multi-method simulation models to solve CS problems; (3) an algorithm that recommends appropriate M&S method(s) based on the user selected criteria for user defined objective(s); (4) the implementation and evaluation of multi method simulation models based on the framework's recommendation in diverse domains; and (5) the comparison of multi-method simulation models created by following the multi-method modeling and simulation framework.