

## ABSTRACT

Attallah, Sherif. Ph.D., Purdue University, August 2014. A Life Cycle Analysis Approach for the Enhancement of Sustainability Decision-making in the Construction Industry Using Agent-Based Modeling. Major Professor: Amr Kandil.

The construction industry is characterized by its diversity and substantial impact on the environment. To address the environmental concerns of today's construction projects, stakeholders at all levels have begun promoting the adoption of sustainability concepts. Consequently, decisions take place at different levels to achieve this objective. At the project level, project design teams make decisions on the specific sustainability credits to be addresses and the certification level to be targeted. Also, implementation of sustainability practices in construction projects is highly dependent on the policies adopted by governmental agencies at a macro level. It is therefore critical for such decision-makers to understand, in measurable terms, the possible consequence of credit selection and implementing different policies and hence make the decisions that lead to optimum positive results. However, the lack of definitive information about the consequences of these decisions, which is a typical characteristic of sustainability decision making, stands as a barrier to developing fully informed decisions that lead to optimum results.

The objective of this dissertation is to develop decision-support tools for decision-makers to assess the impact of different sustainability policies using various statistical and computation methods, agent-based modeling, and life cycle analysis. In this dissertation, while agent-based modeling is proposed to simulate the diffusion of sustainability in a construction market, discrete event modeling is used to map the interactions of the main stakeholders in order to model the selection of sustainability credits at the project level. Life cycle analysis also is introduced as an objective quantifiable tool to assess the potential saved environmental impact associated with the application of project sustainability credits as a result of targeting certification levels when specific sustainability policies are adopted. The saved impact at different project levels is expanded in order to represent the full market and thereby reach an approximate assessment of the potential saved impact due to applying different policies. The decision support tools developed in this dissertation are demonstrated in case studies from actual construction projects.

