LIFE CYCLE COST-BASED RISK MODEL FOR ENERGY PERFORMANCE CONTRACTING RETROFITS

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A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

Planning, Design and Construction – Doctor of Philosophy

2014
ABSTRACT

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Buildings account for 41% of the primary energy consumption in the United States, nearly half of which is accounted for by commercial buildings. Among the greatest energy users are those in the municipalities, universities, schools, and hospitals (MUSH) market. Correctional facilities are in the upper half of all commercial building types for energy intensity. Public agencies have experienced reduced capital budgets to fund retrofits; this has led to the increased use of energy performance contracts (EPC), which are implemented by energy services companies (ESCOs). These companies guarantee a minimum amount of energy savings resulting from the retrofit activities, which in essence transfers performance risk from the owner to the contractor.

Building retrofits in the MUSH market, especially correctional facilities, are well-suited to EPC, yet despite this potential and their high energy intensities, efficiency improvements lag behind that of other public building types. Complexities in project execution, lack of support for data requests and sub-metering, and conflicting project objectives have been cited as reasons for this lag effect. As a result, project-level risks must be understood in order to support wider adoption of retrofits in the public market, in particular the correctional facility sub-market.

The goal of this research is to understand risks related to the execution of energy efficiency retrofits delivered via EPC in the MUSH market. To achieve this goal, in-depth analysis and improved understanding was sought with regard to ESCO risks that are unique to EPC in this
market. The proposed work contributes to this understanding by developing a life cycle cost-based risk model to improve project decision making with regard to risk control and reduction. The specific objectives of the research are: (1) to perform an exploratory analysis of the EPC retrofit process and identify key areas of performance risk requiring in-depth analysis; (2) to construct a framework describing the sources of and mitigation strategies employed for assessing key risks in EPC retrofits; (3) to develop a strategy for analyzing and evaluating risks for EPC retrofits focused on managing expected costs throughout the project life cycle, and use data collected through this strategy to develop and parameterize a risk model; and (4) to demonstrate the applicability of the proposed life cost-based risk model through a pilot application to a case study site.

Five major contributions to the body of knowledge resulting from the research include: (1) a consensus-based assessment of ESCO risk management; (2) characterization of EPC retrofit risks borne by ESCOs; (3) an empirical evaluation of scenario failure mode and effects analysis and its application to this domain; (4) development and pilot application of a life cycle cost-based risk model; and (5) future expansion of the research approach to other domains.

The researcher envisions that full implementation of the research will further encourage the growth of the energy services industry, and support focused retrofits in complex building types that typically can benefit the most from such work. Ultimately, this will reduce the energy consumption of public sector buildings to levels that are more fitting with the global principles of sustainability and responsible management of constrained resources.