

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1: INTRODUCTION**

This chapter presents the methodology used to meet the identified research objectives. The methodology details the construct of the research and analysis including: research design, population and sample, framework, research method, data collection, criteria for data collection, data analysis, and data processing.

#### **3.2: RESEARCH DESIGN**

The following research utilizes both an explanatory and descriptive design. Research has been designed to primarily measure quantitative performance data and uses a quantitative approach. There are two main topic areas for data collection and analysis, which include post-occupancy performance and additional perceived benefits applicable to ISB's Cultural Center. The post-occupancy performance analysis includes financial performance and environmental performance, and additional performance. As this research includes two categories of analyses, they are referred to throughout the methodology as follows: Post-Occupancy Performance: Financial and Environmental Analysis, and Additional Perceived Performance Benefit Analysis.

**Post-Occupancy Performance: Financial & Environmental Analysis (POP):** The POP analyzes the post-occupancy performance of LEED certified buildings in terms of financial and environmental performance. An explanatory research approach is used since the key variables and variable relationships have been defined. A longitudinal study is used, as performance is a panel study designed to trace the sample over time. Quantitative research is used to analyze the financial and environmental performance, and has been modeled after the earlier POP studies.

**Additional Perceived Performance Benefit Analysis (APB):** In this analysis perceived benefits associated with LEED certification such as employee comfort, satisfaction, health, and productivity are analyzed. Key variables are clearly defined and former studies have indicated that a relationship does exist between independent and dependent variables; however, as there is no standard method of estimation for perceived benefits, the results are not definitive. Therefore, a descriptive research design is designated. A quantitative, cross-sectional research design was utilized to describe perceived performance for an isolated period of time, as research was limited by time constraints. Additionally, historical data for ISB's perceived performance was not available.

### 3.3: METHODOLOGY FRAMEWORK

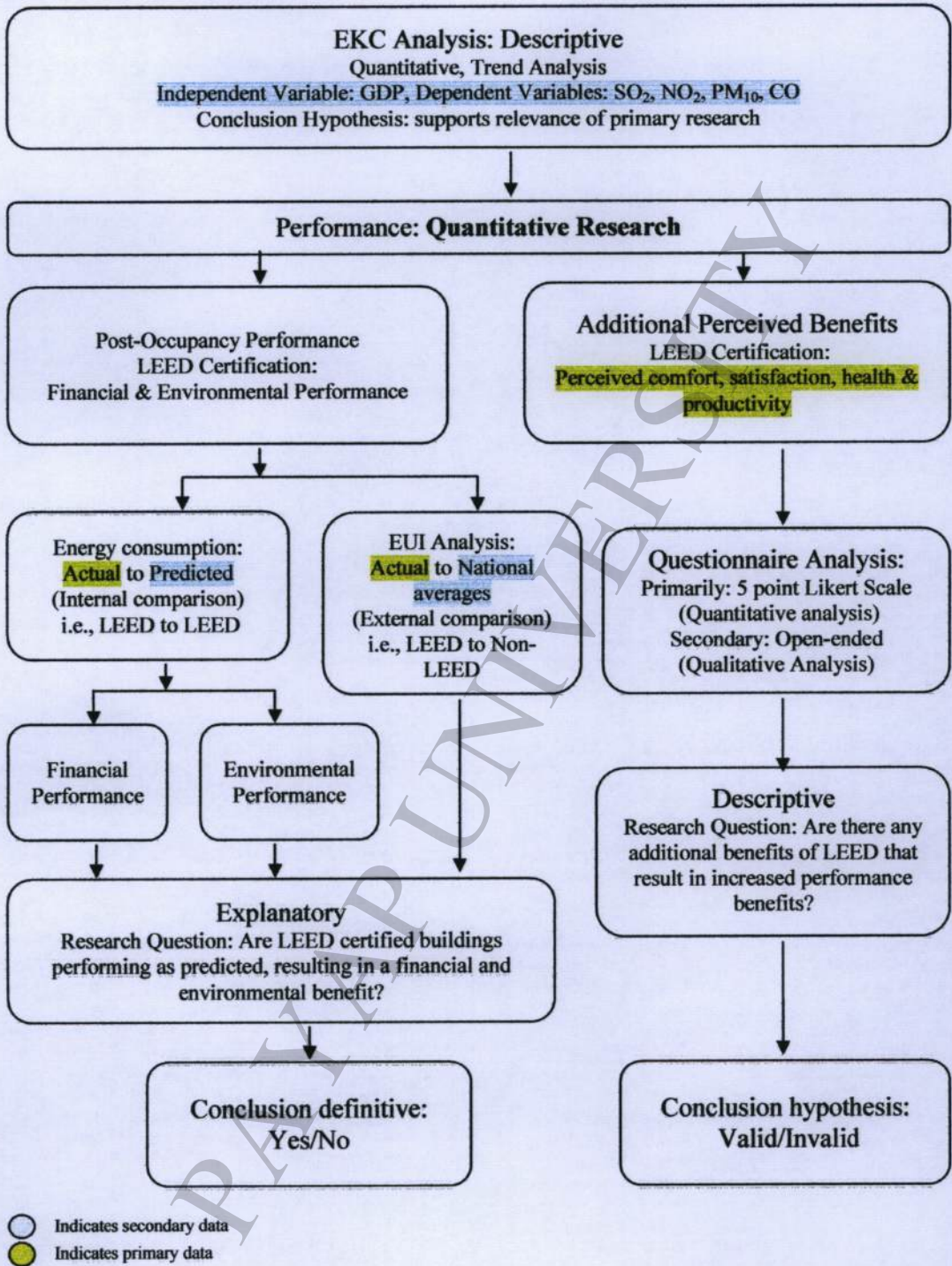


Figure 3.1: Methodological Framework

### 3.4: RESEARCH POPULATION & SAMPLE

**Post-Occupancy Performance: Financial & Environmental Analysis (POP):** The population consists of all LEED certified buildings located in Thailand. At the time this research began, there were 5 LEED certified buildings in Thailand including: Colgate-Palmolive (manufacturing), Energy Complex (mixed use commercial), InterFace Flor (manufacturing), International School of Bangkok (education), USAID RDMA (office). All five buildings are located in Bangkok or the greater Bangkok Metropolitan area. The buildings end-use varied from industrial/manufacturing, commercial and education. The post-occupancy performance study was designed as a sample census. Due to the extremely small population, a sample census offers a larger data set providing more information and a better representation of overall performance. However, only population elements which met the data criteria were eligible to participate in the study. Therefore, the International School of Bangkok's Gold Certified Cultural Center was chosen as a case study because it was the only population element which met the participant criteria outlined in the "Data Criteria" section of this chapter. ISB's Cultural Center represents 20 percent of the total population and provides valuable insight into the post-occupancy performance of LEED certified buildings in Thailand. ISB is located in Bangkok and is a private international school. The Cultural Center is a mixed used building which includes classrooms, music practice rooms, and a performing arts theater. The Cultural Center has been operating at full occupancy since August of 2011.

**Additional Perceived Performance Benefit Analysis (APB):** The population for the APB analysis includes all staff members working at the International School of Bangkok's Cultural Center. Similar to the POP sample the APB analysis is a case study in which a sample census was utilized, due to the limited availability of data. The sampling technique is further refined as a volunteer sample method, in which all occupants of the Cultural Center were asked to participate.

### **3.5: RESEARCH METHOD**

Research uses a mixed method which is described for each of the three analysis categories as follows:

**Post-Occupancy Performance: Financial & Environmental Analysis (POP):** The POP analysis uses a mixed method in which primary data was gathered through an in-depth interview in order to identify the driving factors that encouraged ISB's decision to invest in LEED. The in-depth interview was used to identify ISB's perception of LEED and expected value. Additionally, it was used to gather company documents detailing energy and water consumption. A general building survey was conducted to provide general project information including: location, square meters, primary building activity, date of full occupancy, LEED certification level, sustainable features, and project team. Energy consumption, water consumption, and the general building survey are used to derive financial and environmental performance. Secondary data was collected from the project team and government agencies to be used as comparison data.

**Additional Perceived Performance Benefit Analysis (APB):** The APB uses a mixed method. The quantitative analysis utilizes a five point Likert scale survey to analyze eight key comfort and satisfaction metrics including: overall physical environment, air quality, temperature comfort, lighting comfort, noise level, privacy, health, and productivity. Additionally, the survey includes a secondary qualitative analysis generating data through the use of open-ended questions, in which occupants were given an opportunity to identify any additional areas of satisfaction/dissatisfaction that were not already addressed in the survey, allowing participants to more fully describe perceived performance.

### **3.6: DATA COLLECTION**

Data Collection took place between January 2011 and July 2012. The following section details data collection for each of the three analysis categories as follows:

**Post-Occupancy Performance: Financial & Environmental Analysis (POP):** The POP uses both primary and secondary data. Primary data was obtained from the International School of Bangkok on March 7, 2012. Secondary data was provided by the Metropolitan Electrical Authority (pricing structure, greater Bangkok area), Metropolitan Waterworks Authority (pricing structure, greater Bangkok area), and from the Ministry of Energy's Department of Alternative Energy Development & Efficiency's Building Database. The modeled performance estimates were provided by project team member, Ms. Katie Fallowfield, Senior Built Ecology Consultant at WSP Group via email correspondence between March 7 and May 23, 2012.

**Additional Perceived Performance Benefit Analysis (APB):** The APB utilizes primary data collected through the International School of Bangkok as a voluntary, occupant survey. The survey ran from April 6 to April 13, 2012.

### **3.7: DATA CRITERIA**

**Post-Occupancy Performance: Financial & Environmental Analysis (POP):** Participants of this study must be LEED certified buildings in Thailand which can provide a minimum of at least one year of measured energy consumption data. The data set must be provided for a one year period of time after the date of full occupancy. Data provided before a building was operating at full capacity will be excluded from the study. All participants must be able to provide the modeled baseline performance prediction and performance prediction estimates that were submitted during the LEED certification process.

**Additional Perceived Performance Benefit Analysis:** Participants of the occupant comfort and satisfaction survey must be fulltime employees at the International School of Bangkok. In addition, they must spend a minimum of 70 percent of their working hours in ISB's LEED certified Cultural Center.

### **3.8: DATA ANALYSIS**

**Post-Occupancy Performance: Financial & Environmental Analysis (POP):** The POP uses both primary and secondary data and was designed as a panel study to trace the sample over time. The POP is a comparison analysis using quantitative data to make a quantitative analysis. Estimation methods are fully described in “Method of Estimation.”

**Additional Perceived Performance Benefit Analysis (APB):** The APB uses primary data in a content analysis of quantitative data generated through Likert-survey results. Additionally, the APB uses a qualitative analysis to analyze qualitative data corresponding to open-ended questionnaire results. A content analysis is utilized to identify reoccurring, LEED derived perceptions. Reoccurring perceptions, both negative and positive, are then described and summarized.

### **3.9: DATA PROCESSING**

All recorded primary and secondary data has been reviewed, edited, and encoded after being examined for completeness and consistency in all details. Descriptive information is numerically coded and entered into SPSS for data processing. All raw data is then edited for the final review and tabulations are prepared. Results are tabulated after several stages of data correction.