THE GREENING OF THE PROJECT MANAGEMENT CYCLE IN THE CONSTRUCTION INDUSTRY

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Email: submit@agsbresearch.org
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Eliseo A. Aurellado
Ateneo de Manila University
Graduate School of Business

Introduction

The turn of the 21st century saw a surge in the demand to be “green”. The general public’s environmental awareness, the demand from consumers at all levels for more energy-efficient products, and the increasing prices of fossil fuels, have all conspired to put pressure on businesses to be more environment-friendly. This new trend has also gained momentum in the construction industry and has helped create structures and products that are more compatible with nature, less polluting, long-lasting, more efficient, and with competitive costs. It has given rise to green certification initiatives that provide objective ways to determine whether a building is complying with green principles or not.

Green building design is believed to have been around for thousands of years because buildings originally were
designed to meet climatic conditions (Yellamraju, 2010). Examples of climate-responsive buildings would be the typees of the Native Americans, the igloos of the Eskimos, the tents of the Arab nomads, and the adobes of the Pueblo Indians. According to Yellamraju, “Good building design should be inherently green-oriented to maximize the benefits of sunlight and wind, with an envelope that is designed in response to the local climate and with building systems and components that are energy, water, and resource efficient.”

He asserted that with the advent of heating and air conditioning systems, the new building designs began to ignore nature and locale so that buildings became alien to their environment. However, this trend was arrested in the wake of the energy crisis of the 1970s. With the drop in oil prices in the 1980s and the boom in economies, designs continued to develop energy-inefficient buildings. Yellamraju claimed that the resurgence of green buildings in the 21st century was due to the following factors: (1) increased awareness of contribution of buildings to global climate change; (2) emergence of green building rating systems; (3) cost-effectiveness of building green; (4) government incentives; and (5) availability of new resources, materials, and technologies.
Today, buildings are reported to be one of the biggest consumers of energy around the world. For example, the United States registers 17 percent fresh water withdrawals, 25 percent wood harvest, and 33 percent CO2 emissions. A staggering 48 percent of primary energy consumption goes into construction of buildings. All of these have contributed significantly to global warming, with the building industry being responsible for 40 percent of greenhouse gas emissions in the United States alone.

The need for energy-efficient and eco-friendly buildings has given rise to green designs and green building rating systems such as LEED in the U.S., Canada, India and the Philippines; BREEAM in the UK; Green Star in New Zealand, Australia and South Africa; CASBEE in Japan; Green Building Index in Malaysia; Green Marks in Singapore and BERDE in the Philippines. Even the biggest energy consumer of the world, China, is realizing the need to be green for the long haul. It has introduced its own green system called the Three-Star Green Building rating system.

While the cost-effectiveness of building green is being debated, there appears to be some positive signs in its favor, especially the availability of government incentives such as what are offered in the United States—e.g., tax rebates/benefits and price discounts on the purchase of environment-friendly materials. These incentives are available even to small-home owners. New resources and materials that are kinder to the environment are constantly being made available such as engineered wood made out of renewable materials, LED lighting systems, solar panels, energy star-certified electronics, and toilet fixtures that use less water.
The Philippine Scene

In the Philippines, the design of dwelling units and office buildings has evolved through the ages from caves to lean-to’s, from *nipa* huts to stone houses, and finally to modern structures. While they generally followed function, the more modern designs have borrowed themes from foreign lands. These address aesthetic objectives but do not adapt to the country’s particular climate, which is generally wet, humid and hot. This design anomaly has prompted some architects to go back to the basic concept of the *nipa* hut (see Figure 1) as an inspiration when constructing sustainable buildings.

*Figure 1. Nipa Hut*


Architect Bobby Mañosa, famous for his Coconut Palace, was cited in the book *Beyond the Bahay Kubo* by Caruncho (2012). He believed, like his son Angelo, that “the nipa hut or *bahay kubo* was the original sustainable house. In its form, it already embodies all the design principles thought of as ‘green.’”
Mañosa enumerated the nipa hut’s green design principles as follows: It features (1) indigenous materials that are renewable and readily available at little cost; (2) tall, steeply-pitched roof that sheds monsoon rain while creating ample overhead space for dissipating heat; (3) long eave lines that provide shade; (4) the silong underneath the house that creates a simple, utilitarian space while allowing ventilation from below through the bamboo slat floors; (5) large awning windows, held open by a simple tukod (sturdy rod) that provide cross ventilation and natural light; (6) structural strength that can withstand adverse conditions such as typhoons and volcanic ash fall. In short, the nipa hut represents a sturdy, comfortable, and sustainable building that is energy-efficient. The nipa hut also inspired the bahay na bato (stone house) (Figure 2), which characterized rich people’s houses during the Spanish colonial times as towns began to urbanize. A good example of these stone houses would be those in Vigan, a world heritage city.

![Figure 2. Stone House (Bahay na Bato)](http://myphilippinelife.com/philippine-house-ideas/oldhouse2-3/)

The move toward green buildings in this country has been encouraged, particularly due to the increased cost of energy to maintain dwellers’ or occupants comfort. Christopher Cruz de la Cruz, chair and president of the Philippine Green Building Council and proponent of the BERDE Philippine rating system, pointed out that 60 percent of energy bills comes from air conditioning alone. Mañosa may not find this surprising because he had earlier noted that foreign architectural models have little regard for the country’s tropical climate, thus resulting in buildings that are encased in glass which, in the absence of air conditioning, make them unbearable ovens during summer. These buildings often show facades streaked with watermarks because their flat roofs are not designed for rainy seasons.

Another noted architect who believes in environment-friendly building designs is Felino ”Jun” Palafox, who claimed that his company’s triple bottom-line approach is what makes it unique: “People first or social equity, then planet earth or the environment (underscoring provided by the author), and finally, profit or economic goals. If one of the three legs of this triple bottom-line is missing, then we don’t take the project,” he said. “Some people call me a maverick. Some call me controversial when we crusade for the environment---giving up projects or even exposing those people who destroy the environment.”

Palafox is noted for his “adaptive architecture” such as his floating houses and structures that are designed to float in flood-prone areas using floating mechanisms made of rubber boats, plastic bottles or bamboo. He has also advocated the construction of elevated establishments and walkways as a protection against floods, and garden
Characteristics of Green Buildings

What makes green buildings different from ordinary buildings? The characteristics of green buildings are usually the following:

1. Passive cooling – temperatures inside buildings are kept down through cross-ventilation, appropriate vents, water installations, building orientations away from the sun’s path, and insulation

2. Natural lighting – use of natural light rather than artificial light through proper positioning of windows and doors and the use of skylights

3. Water management – conservation of water through ‘grey’ water systems that collect rain water and through water recycling
4. Minimized carbon footprint – use of indigenous and recyclable materials, greenery, and low-volatility organic compounds such as paint

5. Alternative energy – use of solar power and solar panels, and energy-saving devices

The growing awareness for global warming and climate change in this country, coupled with concern for soaring energy costs, has prompted the construction industry to design and construct buildings in accordance with green principles. There are now pioneering groups of professionals who spearhead such effort. One is the Philippine Green Building Council, the proponent of the Building for Ecologically Responsive Design Excellence (BERDE); the other is the LEED Accredited Professional’s Association.

**Objective of the Study**

This study aims to get insights on the green building technology, especially as it relates to Philippine conditions and to assess its costs-and-time impact on the project management cycle in the construction industry.

The question here is: “to LEED or not to LEED?” Or alternatively, “to go BERDE (green) or not to go BERDE?”
Methodology

The research relies mainly on secondary sources of data and information and the results of a survey of LEED/BERDE practitioners, owners and construction managers. The data are supplemented with information sourced from BERDE, the Philippine counterpart of LEED.

The Concept of LEED

What is LEED? Leadership in Energy and Environmental Design (LEED) is a voluntary, consensus-based, market-driven program that provides third-party verification of green buildings (i.e., the LEED-accredited professional).

The United States Green Building Council (USGBC) was co-founded by Mike Italiano, David Gottfried, and Rick Fedrizzi in 1993 as a non-profit trade organization that promotes sustainability in how buildings are designed, built, and operated. The USGBC is best known for the development of the LEED green building rating systems and Greenbuild, a green building conference and expo that promotes the green building industry, including environmentally responsible materials, sustainable architecture techniques, and public policy. The USGBC was one of eight national councils that helped found the World Green Building Council in 1999.
Although LEED originated in 1994 in the United States, it has become an internationally recognized green building certification system over the years. From 1994 to 2006, LEED grew from one standard for new construction to a comprehensive system of six inter-related standards covering all aspects of the development and construction process. Also, LEED has grown from six volunteers for one committee to more than 200 volunteers for nearly 20 committees with nearly 200 professional staff. To-date, LEED projects have been successfully established in 135 countries with more than 50 percent of the total LEED-registered square footage being developed outside the United States.

In the LEED accreditation program, various rating systems exist to address different types of building projects, including healthcare facilities, schools, homes, and even entire neighborhoods. A certification is provided by a third-party who verifies whether the building or community was designed and built using strategies aimed at improving performance (e.g., energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts).

To be LEED-certified, there are certain principles that must be followed such as substantial reduction of water consumption through water recycling and low-flow plumbing fixtures; lower energy costs through reflective materials, energy-efficient appliances and fixtures, lights with automatic sensors; and highly efficient systems to filter the air and monitor carbon dioxide for a healthier indoor environment.
A project must satisfy all LEED prerequisites. Commercial buildings and neighborhoods must earn a minimum 40 points on a 110-point LEED rating system scale while homes must earn a minimum of 45 points on a 136-point scale (See Figure 3 for LEED project categories).

Figure 3. Categories of LEED
Source: Green Building Council

There are four (4) levels of certification depending on points earned (Figure 4):

Figure 4. LEED Certification Levels
Source: Green Building Council
LEED has multiple credit categories, of which seven are of prime importance. Within each category, points are assigned. Each building/development must earn a minimum number of credit points to achieve certification.

**Main credit categories (Figure 5)**

- **Sustainable sites credits** encourage strategies that minimize the impact on ecosystems and water resources.

- **Water efficiency credits** promote smarter use of water, inside and out, to reduce potable water consumption.

- **Energy and atmosphere credits** promote better building energy performance through innovative strategies.

- **Materials and resources credits** encourage using sustainable building materials and reducing waste.

- **Indoor environmental quality credits** promote better indoor air quality and access to daylight and views.

**Additional LEED for neighborhood development credit categories**

- **Smart location and linkage credits** promote walkable neighborhoods with efficient transportation options and open space.
The Concept of LEED

- **Neighborhood pattern and design credits** emphasize compact, walkable, vibrant, mixed-use neighborhoods with good connections to nearby communities.

- **Green infrastructure and buildings credits** reduce the environmental consequences of the construction and operation of buildings and infrastructure.

Additional LEED for homes credit categories

- **Location and linkage credits** encourage construction on previously developed or infill sites and promote walkable neighborhoods with access to efficient transportation options and open space.
• **Awareness and education credits** encourage home builders and real estate professionals to provide homeowners, tenants and building managers with the education and tools they need to understand and make the most of the green building features of their home.

**Two bonus credit categories**

• **Innovation in design or innovation in operations credits** address sustainable building expertise as well as design measures not covered under the five LEED credit categories. Six bonus points are available in this category.

• **Regional priority credits** address regional environmental priorities for buildings in different geographic regions. Four bonus points are available in this category.
In the country, the counterpart of the U.S. Green Building Council is the Philippine Green Building Council (PHILGBC) (Figure 7). The PHILGBC was incorporated on March 22, 2007 as a national non-stock, non-profit organization that promotes the sharing of knowledge on green building practices to the industry to ensure a sustainable environment.

The Building for Ecologically Responsive Design Excellence (BERDE) is the Philippines’ own green building rating system that is developed by PHILGBC and is used to measure, verify, and monitor the environmental performance of buildings that exceeds existing mandatory building and environmental regulations and standards. As part of its public-private partnership, the PHILGBC is working on the BERDE Green Building Rating Systems with the Department of Energy under the Philippine Energy Efficiency Project - Efficient Building Initiative.

As opposed to the LEED credit point system, the BERDE certification system has 11 categories (Figure 8) as basis for certifying a newly constructed building. These include:

The Concept of LEED
• **Management.** Focuses on the building’s environmental performance from pre-construction or design to commissioning and operation. It includes compliance with national and local laws and establishment of teams to address different environmental issues.

• **Land Use and Ecology.** Tackles different issues on the condition and the development of the site during the certification period. It includes integrated design process for pollution control and encourages environment-resilient site development.

*Figure 8. 11 Areas in BERDE Certification*
Source: Philippine Green Building Council
• **Water.** Addresses the reduction of potable water consumption and wastewater discharge.

• **Energy.** Focuses on the reduction of energy consumption.

• **Transportation.** Focuses on lessening transport circulation and encourages the use of alternative transportation, thus lowering emission and use of energy. It also deals with the proximity of key establishments, public access, and transport amenities to reduce extended travels.

• **Indoor Environment Quality.** Deals with human comfort, lighting, thermal levels, acoustics, and views.

• **Materials.** Deals with hazardous substances, measure of recycled content, and the building materials’ reduction of CO2 emissions.

• **Emissions.** Pertains to the building’s emissions and ways to measure and prevent further emissions.

• **Waste.** Involves waste management in the building from design to construction, operation, and deconstruction stage.

• **Heritage Conservation.** Deals with the conservation of Philippine historic and heritage sites and preservation of the country’s
culture. (Note: This is one area where BERDE has made a pioneering contribution to green building concepts. It is not present in LEED).

- **Innovation.** Focuses on encouraging the industry to go above and beyond the rating scheme, and to recognize and reward those who innovate new technology, design, and processes that will impact the environmental performance of the building.

Although there is an overlap on certain categories, the BERDE system actually takes into account the aesthetic and cultural aspects of a building’s design. This approach is commendable because it can lead to innovation in the local historical construction or architectural design by incorporating earth-friendly materials. Compared to LEED system, BERDE responds to the ecological needs of the Philippine environment.
Certified Buildings in the Philippines

There are a few buildings in this country that are LEED certified. Foremost of these buildings are:

1) Texas Instruments (TI) plants in Baguio City and Clark.

2) SunLife Financial Building in Global City.

3) Evotech Building in Nuvali TechnoHub in Santa Rosa, Laguna.

4) Zuellig Building in Makati.

5) ARYA Residences in Global City.

6) Asian Development Bank Building in Ortigas.

Texas Instrument’s Building, Baguio City and Clark

Texas Instrument’s (TI) building (Phase 5) in Baguio City is reportedly the first LEED-certified building (Silver rating) in the country although another building, the ADB in Ortigas makes the same claim with a LEED Gold rating. The TI building has features that enable it to operate efficiently with less impact on the environment. Energy reduction is 24 percent and water consumption reduction is 70 percent. This is made possible through building insulation and reflective roofing, and recycling of waste water. Eighty-five percent of its workforce uses TI-provided mass transport.
The company’s 780,000 sq. ft. assembly/test facility in Clark-Angeles, Pampanga, features the following energy saving measures:

1) Highly-reflective roof and 11,000 sq. ft. of vegetative roofing to reduce heat gain and slow water runoff.

2) Natural lighting and light sensors.

3) Desiccant wheel air handling unit to provide de-humidified fresh air for more efficient cooling. (Desiccant is reused after being dried using waste heat).

4) Environmentally responsible building materials such as recycled and locally produced items, low-carbon emitting materials such as adhesives, sealants, and carpeting for better indoor air quality, and recycling of construction waste.

5) Water management features reclaimed water used for toilet flushing and water condensation for site irrigation during the dry season, and a site detention pond for water runoff and better rain absorption. More than 70 percent of the site is preserved or restored with native plants to minimize water runoff and reduce landscape maintenance. Other water streams are reclaimed for use in cooling towers and scrubber systems.

6) Efficient commuting is provided by two bus lines and local jeepneys. There is preferred parking for low-emission vehicles. Bicycles are
provided parking spaces. Showers and lockers are provided for employees who cycle to work.

**SunLife Financial Building in Global City**

The SunLife Financial Building has already been pre-certified by the LEED for Core and Shell Development. It is also raring to be certified for LEED Commercial Interiors. It is working toward being the first green building in the Philippines to receive the Gold level LEED certification for Core and Shell development and for Commercial Interiors. Green features of the building include:

1) Lower energy costs: Low emissivity glass allows daylight to come in while blocking outside noise and heat, helping reduce harmful emissions and minimize the use of cooling devices.

2) The green roof has a rain harvesting system that captures rainwater for non-potable usage. The green roof also mitigates the "heat island effect", a phenomenon where buildings are transformed into pocket islands of heat. Because of vegetation, the SunLife building’s green roof absorbs the urban heat while serving as an outdoor garden.

3) The building also addresses the "sick building syndrome," a term referring to ailments mostly related to poor indoor air quality, usually from a building’s ventilation system. Given the reduced use of air conditioning and
the increased circulation of natural air, Sun Life’s new home is beneficial to the wellness of its tenants.

**Zuellig Building, Makati City**

Zuellig Building is a 33-storey “bamboo-and-flowing-water”-inspired building that has become the country’s first pre-certified Gold LEED building. It is set to enjoy 15 percent energy savings or a minimum of 4.3 million kilowatt hours saved per year. Ninety percent of tenants’ interior spaces will use natural daylight. The building will employ a CO2 monitoring system to ensure occupants’ health and safety.

The project’s achievement in terms of energy consumption and reduced carbon footprint is reported to include the following:

1) 16 percent energy savings against the base mode.

2) 40 percent water usage savings; 50 percent reduced water use for landscaping.

3) 0 percent use of CFC refrigerant.

4) 50 percent waste diverted from landfill and 20 percent use of regional material.

5) 75 percent of Zuellig’s space has good daylight characteristics while 90 percent of the space presents good views of the external environment.


Evotech Building in Nuvali TechnoHub, Santa Rosa, Laguna

The four-level building in the campus-like setting of the Nuvali TechnoHub serves as a model for those who are concerned about carbon footprints, in terms of the following areas:

1) This building uses some very basic design rules incorporated into its structure such as orienting the building away from the sun’s hottest rays and using sunscreens in areas exposed to direct sunlight, thus achieving high-energy savings.

2) In 2010, its energy consumption measured a mere 74kwh/sqm which was way below the ASEAN base standard of 200kwh/sqm. Further saving was achieved by installing an innovative and district cooling air-conditioning system with a central plant that provides chilled water through an underground loop for a number of buildings. One Evotech provides 14 percent energy cost savings for its tenants.

3) Recycled water is used for toilet flushing, and water consumption savings through landscape irrigation is as much as 45 percent of potable water than the average building. One Evotech’s water efficiency was registered at 0.54 m3/sq. m. or 0.10 below the adopted standard.

Certified Buildings in the Philippines
4) A less obvious sustainable feature is the use of pervious pavements that allow rainwater to quickly seep into the water aquifer while reducing storm water runoff.

5) During the construction of One Evotech, Ayala Land exerted remarkable effort to reuse and recycle its construction debris. As a result, the project has diverted 87 percent of on-site generated construction waste from landfill.

**ARYA Residences**

Arya Residences is the country’s first LEED-registered residential community. Its projected efficiency stems from its integrated sustainability design features. For example, the towers receive lesser heat, require less potable water to maintain, and utilize technology that provides residents the opportunity to reduce their reliance on valuable resources, thus lowering the negative impact to the environment. Based on the LEED standard, Arya Residences’ features are designed to provide:

1) As much as 40 percent savings in potable water usage.

2) At least 14 percent savings in electricity usage.
Asian Development Bank

In 2011, ADB received the LEED Gold rating from the U.S. Green Building Council, making ADB’s headquarters the first building in the Philippines to be awarded LEED certification for an existing structure. The ADB has incorporated various mechanisms to achieve a LEED gold certification. The multiple methods used are:

1) Heat reduction from the tree shading of open car parks, high solar reflectance index of paved roadway and environment-friendly transportation options, such as immediate access to public transportation and promotion of carpooling.

2) Management of storm water. The new rainwater-harvesting facility has reduced rainwater runoff by more than 30 percent. Also, 100 percent utilization of non-potable and treated water from the sewage treatment plant for toilet flushing and watering the plants.

3) Building Automation System (BAS) monitors needs and automatically adjusts to match supply and demand for everything from air conditioning to lights. Reduction in outside light pollution through full and partial shielding of exterior lights that are above 50 watts.

4) Installation of whole-building metering and sub-metering as well as a new cooling tower water management. The system detects problems that can lead to corrosion and
bio-fouling and delivers a chemical response, ensuring cooling safety and efficiency. Replacement of air-conditioning chillers and pumps, and use of non-chlorofluorocarbon refrigerant.

5) Most of building materials are bought locally. Follows the 3Rs – Reduce, Reuse, Recycle.

6) To improve indoor air quality, air is purged from and replaced at the ADB headquarter three times a week. Also, a no-smoking policy within the building is strictly implemented.

7) ADB’s green cleaning program uses environment-friendly cleaning products and materials.

On 5th June 2012, the President of the Asian Development Bank opened a new rooftop solar power project that will provide clean, renewable energy to ADB’s 20-year-old headquarters in Manila. The 2,040 photovoltaic panels occupying 6,640 square meters on the roof of ADB’s main building will generate 613 megawatt hours of electricity per year to run a portion of the Bank’s air conditioning, lighting, and computer systems, thus reducing its carbon footprint.
While the buildings cited in the preceding sections prove how energy cost savings and more favorable in-door atmosphere quality are possible, there is a dearth of available detailed study on green buildings. There is also a difficulty in identifying differences in costs between traditional buildings and LEED-certified ones because the contract amounts of LEED buildings already incorporate the costs of green materials and technology, and documentation of these differential costs are not normally done. However, one significant LEED building in Metro Manila, where the air conditioning, lighting and computer systems were controlled, reportedly registered savings of 33 million kilowatt hours of electricity within a six-year period. This is equivalent to 18,000 tons of avoided carbon dioxide emissions.

In the United States where LEED originated, certain studies have been made. As Yellamraju indicated in his book, energy-use intensity of LEED buildings is 24 percent better than average. In terms of financial returns, LEED buildings showed premiums in space rental rates, higher resale value, with 3.6 percent higher occupancy due to greater demand. In terms of occupant productivity, there are 2.8 fewer sick days and a 55 percent increase in productivity. Based on these studies, there appears to be certain advantages in going green.
The Impact of Green Technology on Project Management

While green building technology is desirable because of the abovementioned benefits, certain concerns become apparent when project owners decide to go green. The usual questions asked are: Will going green entail higher costs in terms of design and construction? Will the project management period extend as a result of the design and building requirements of getting green-certified? While the answers to these questions may vary among building practitioners and project owners, there seems to be consensus that managing green building projects is different from that of the traditional.

For an appreciation of the perceived difference in the project management of green buildings, consider the following process flow in construction (Figure 9):
The normal process of designing and constructing a building starts with the project concept of the owner. An architect is then engaged to translate this concept into a visual representation through schematic drawings based on the owner’s specifications. This phase can take several iterations depending on the ability of the architect to create an aesthetic and functional design. Sometimes, the engagement of an architect is determined on the basis of a design competition where the winner is then engaged to prepare the detailed drawings. Usually, the architect

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The Impact of Green Technology on Project Management

**Figure 9.** Comparison of LEED and Non-LEED Design and Construction Process

Source: Author
engages other designers such as the structural engineer, who prepares the design for the structural framework of the building. Other designers are also called in to render the mechanical-electrical-plumbing and fire protection (MEPF) systems. When all the designs and building plans are finalized, the project is bid out, usually through the project owner’s representative, i.e., the construction manager. The construction manager prepares a short list of invited contractors, who are then requested to prepare competitive bids based on the designs and construction drawings. After the project is awarded to the winning contractor, the necessary building permits are secured from the local government unit and construction begins. Normally, construction can take anywhere from six months to three years, depending on the complexity of the structure. Here, the construction manager and the constructor work closely to keep the schedule on track, with frequent consultations with the architect and other designers. There are customary rituals during construction such as groundbreaking and topping-off ceremonies. After the building is fully completed and accepted, there is a one-year warranty period where the contractor continues to be responsible for rectifying defects due to workmanship or faulty materials.

While the traditional project management process involving the project owner or his representative (i.e., the construction manager), designers (structural and architectural) and the constructor is still in progress, a new component is added – LEED consultations with an accredited LEED professional. From the initial objective-setting to the design and final implementation of the building project, the LEED professional plays a key role in helping attain the LEED certification.
Survey on LEED Practice

To try to validate some of the findings from literature on green building technology, to infuse a local context to LEED, and to assess the practices of BERDE, a survey, albeit limited, was conducted among LEED and BERDE practitioners. The results are tabulated in Table 1 below. Percentages in the table refer to the number of responses relative to the total population surveyed.

The survey was not designed to use random sampling; instead, it was directed at a short list of architects and engineers involved in LEED and BERDE-certified buildings. Hence, the results of the survey are not adequate for making valid statistical inferences but are sufficiently indicative of the general sentiment of the pioneers in green building technology.

Table 1. Tabulation of Survey Results

<table>
<thead>
<tr>
<th>Survey Responses</th>
<th>LEED or Berde Familiarity</th>
<th>Reason for LEED; BERDE</th>
<th>Difference LEED Vs Conventional</th>
<th>Design Process Length</th>
<th>Construction Process Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>Through 62.5%</td>
<td>Environment 80.0%</td>
<td>Very Different 62.5%</td>
<td>Increase 87.5%</td>
<td>Increase 75.0%</td>
<td></td>
</tr>
<tr>
<td>Adequate -25.0%</td>
<td>Prestige 60.0%</td>
<td>Somewhat Different 37.5%</td>
<td>No Increase 12.5%</td>
<td>No Increase 25.0%</td>
<td></td>
</tr>
<tr>
<td>Somewhat 12.5%</td>
<td>Own Initiative 25.0%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Author
Table 1-A. Tabulation of Survey Results

<table>
<thead>
<tr>
<th>Impact on Cost</th>
<th>Costs most Incurred?</th>
<th>LEED/BERDE Costs VS Benefits</th>
<th>Will Choose LEED next time?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly Significant 0.0%</td>
<td>Materials 58.3%</td>
<td>Beneficial 75.0%</td>
<td>Yes 58.3%</td>
</tr>
<tr>
<td>Moderately Significant 100.0%</td>
<td>Design 41.6%</td>
<td>Not Beneficial 25.0%</td>
<td>No 16.6%</td>
</tr>
<tr>
<td>Not Significant 0.0%</td>
<td>Monitoring/Documentation 50.0%</td>
<td></td>
<td>May Be 25.0%</td>
</tr>
</tbody>
</table>

Source: Author

The study came up with the following results:

1. Owners, their representatives or consultants perceived themselves to be "adequate" to "thoroughly familiar" with LEED and BERDE concepts and principles. However, owners and/or their representatives are less familiar with the concepts than do the consultants. This is understandable since LEED is a fairly new mode of design and construction in the country, and consultants are expected to have the expertise to guide the owners on the subject and help pass the qualifying exams to be accredited.

2. Most project owners and consultants opted for LEED certification because of environmental concerns (80% of respondents), prestige (60%), and on their own initiatives, particularly as a marketing agenda and
because of the potential energy and water consumption savings (25%).

3. Implementing LEED and BERDE is perceived to be "somewhat different" (37.5%) to "very different" (62.5%) from the traditional design and construction projects. Primarily, the difference lies in the purposeful integrated planning of the project’s design and construction so that it meets the required criteria/points to qualify for the targeted LEED/BERDE category certification.

4. Most respondents perceived LEED/BERDE to extend the design process period (87.5%) probably because of the following reasons: the gathering and analysis of data, development and evaluation of design alternatives, decisions on priorities to comply with the prerequisite and points-credit requirements, and the thoughtful process of identifying and procuring environment-compliant materials. A variety of issues, technologies, and approaches must be considered to comply with the certification’s criteria such as environmental quality, energy efficiency, water conservation, and material conservation. For example, in the design phase, depending on the certification goal, there are some required processes that are not normally done but are intended to provide feedback on the effectiveness of the design, such as energy modelling, daylight and lighting simulations, and facade design. The results of these processes are then used to improve further the design.
Respondents also perceived LEED/BERDE to lengthen the construction process period (75%) because of extra requirements for site preparation, better housekeeping, and documentation. For example, in LEED, site impact is minimized by implementing an erosion and sedimentation control (ESC) plan; storm water management plan; and a construction waste management plan. An LEED project team headed by a project administrator is normally organized to gather documentation so as to comply with the prerequisites and credit requirements for LEED certification. The general constructor must be an integral part of the project team. There are specific environmental and sustainability guidelines included in the contract. Drawings and specifications are followed and properly implemented by the constructor and subcontractors. For example, there is the implementation of the indoor air quality (IAQ) management plan and compliance with the LEED requirements on indoor environmental quality (IIEQ).

During construction, regular project teams normally lack the expertise to manage and design LEED projects because of the novelty of the concept. This usually causes problems during construction. Thus, the building commissioning process extends over a longer period.
It is imperative that the constructor, subcontractors, and workers understand the sustainability practices that must be implemented in the project such as (1) Minimizing site impact by implementing soil erosion, rain water management, and construction waste management plans; (2) Procurement of specified equipment and materials to meet the design intent and comply with LEED requirements; (3) Monitoring and verification of building systems as required by the building commissioning authorities; and (4) Identification of suppliers/vendors who can provide recycled-content, locally-produced, rapidly renewable materials, such as certified wood. Since some of these requirements are incorporated into the contract documents, the constructor is expected to have no trouble complying with his contractual obligations, thus ensuring that the project proceeds smoothly. However, as indicated in the preceding statements, the project team’s lack of experience and expertise often gives rise to unexpected conditions that may delay the project implementation.

5. In terms of the additional time needed due to LEED/BERDE requirements, respondents agreed that project design and implementation register ”1-10 percent” (33.3%) and ”over 10 percent” (33.3%) increments.
6. The survey indicated that LEED/BerDE causes a moderate increase (100.0% of respondents) in costs of design and construction. The incremental costs are perceived to be due mainly to materials (58.3%), design (41.6%), documentations, and monitoring (50.0%) requirements. The responses did not provide details on the nature of these materials that could explain the moderate increase in costs. On the overall, the perceived increase in costs could have been validated by a comparative study of the costs of a non-LEED/BerDE versus a LEED/BerDE building on a per-square meter basis but due to the difficulty of obtaining the needed information, no attempt was made to make that comparison in this study. This, though, can be the subject of future research.

Generally, while green materials appear to be more costly, the compensating factor is the reported savings in energy consumption or reduction in carbon footprint over time.

To study whether LEED buildings require more expensive material inputs, a limited canvassing was made to compare non-eco-friendly materials and eco-friendly ones (Table 2). Results showed that while there are disparities in the costs based on the types of materials and brands, it does indicate that the eco-friendly materials are more expensive. Eco-friendly lights and toilet fixtures are definitely more expensive than traditional bulbs and single flush water closets/urinals. Engineered wood, which is similar to plywood in construction, came out cheaper.
than good lumber. Heating gadgets integrated into shower systems are cheaper than heaters that make use of hot and cold water in tanks. Generally, while green materials appear to be more costly, the compensating factor is the reported savings in energy consumption or reduction in carbon footprint over time. This is normally validated by energy studies post-construction.

There is no definitive conclusion on the cost savings generated through the use of eco-friendly materials. However, the indicative prices cited in the above table should give the reader an idea of the potential cost savings in terms of water and energy and how such could compensate the initial higher procurement cost. For example, the waterless Falcon urinal is reported to save 150,000 liters of clean water annually. Assuming a cost of P20/liter, which is the approximate cost of bottled water (although water from a utility company may be cheaper) the annual savings could amount to P3 million, which more than compensates for the difference in the initial high acquisition cost of approximately P6,700.
Table 2. Selected Materials, Canvassed on November 15, 2012

<table>
<thead>
<tr>
<th>Particulars</th>
<th>Unit of Measure</th>
<th>Unit Cost</th>
<th>Eco-Friendly Material Cost Premium (Discount) in percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lights:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CFL 9W</td>
<td>Unit</td>
<td>P76</td>
<td>347%</td>
</tr>
<tr>
<td>CFL 11W</td>
<td>Unit</td>
<td>76</td>
<td>347%</td>
</tr>
<tr>
<td>CFL 15W</td>
<td>Unit</td>
<td>80</td>
<td>371%</td>
</tr>
<tr>
<td>Incandescent bulb -25W</td>
<td>Unit</td>
<td>P 17</td>
<td>347%</td>
</tr>
<tr>
<td>Incandescent bulb -50W</td>
<td>Unit</td>
<td>17</td>
<td>371%</td>
</tr>
<tr>
<td>Fluorescent tube -20W</td>
<td>Tube</td>
<td>51</td>
<td>200%</td>
</tr>
<tr>
<td>Fluorescent tube -40W</td>
<td>Tube</td>
<td>56</td>
<td>229%</td>
</tr>
<tr>
<td><strong>Wood:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PCW, Engineered Wood, SAS 2”x2” Lumber, S4S, KD, 2”x2”</td>
<td>Boardfoot</td>
<td>P68</td>
<td>(29%)</td>
</tr>
<tr>
<td>PCW, Engineered Wood, SAS, 2”x4” Lumber, S4S, KD, 2”x4”</td>
<td>Boardfoot</td>
<td>72</td>
<td>(28%)</td>
</tr>
<tr>
<td><strong>Paint:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permacoat Satin Hygienic White “Boysen”</td>
<td>Gallon</td>
<td>P 648</td>
<td>17%</td>
</tr>
<tr>
<td>Permacoat Gloss Latex White “Boysen”</td>
<td>Gallon</td>
<td>P552</td>
<td></td>
</tr>
<tr>
<td>Permacoat Semi Gloss Hygienic White “Boysen”</td>
<td>Gallon</td>
<td>689</td>
<td>23%</td>
</tr>
<tr>
<td>Permacoat Semi Gloss Latex White “Boysen”</td>
<td>Gallon</td>
<td>560</td>
<td></td>
</tr>
<tr>
<td><strong>Heater:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multipoint, “AEG” 25L storage, “Vector”</td>
<td>Unit</td>
<td>P10,800</td>
<td>(87%)</td>
</tr>
<tr>
<td><strong>Water Closet:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual flush</td>
<td>Unit</td>
<td>P6,200</td>
<td>86%</td>
</tr>
<tr>
<td>Single flush CS998, “HCG”</td>
<td>Unit</td>
<td>P3,328</td>
<td></td>
</tr>
<tr>
<td><strong>Urinal:</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Waterless, “Falcon” With flush, U999, “HCG”</td>
<td>Unit</td>
<td>P9,373</td>
<td>261%</td>
</tr>
<tr>
<td><strong>Cement:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portland cement “Holcim” “Republic” Cement with additives</td>
<td>40kg bag</td>
<td>P225</td>
<td></td>
</tr>
</tbody>
</table>

Source: Author
The growing environmental concerns and high costs of energy have encouraged architects, designers, and constructors to create buildings that are energy-efficient and responsive to climatic conditions. Perceptions on the impact of green technology in terms of cost and time do vary. However, the general consensus is that the initial higher costs (due largely to the preference for environment-friendly materials, the added cost of involving green-certified professionals to oversee and measure the impact of these building projects, and the additional efforts taken by constructors to reduce waste and limit pollution at the jobsites) are eventually compensated by the future savings in energy costs and the relatively non-quantifiable health benefits to the building’s occupants.
Statistics

Size and Impact of the U.S. Built Environment

U.S. Construction market in 2001 (includes all commercial, residential, industrial)

- Represents 20 percent of the US economy

- Comprises 14.2 percent of the $10 trillion U.S. GDP. This includes all commercial, residential, industrial and infrastructure construction. Commercial and residential building construction constitutes 9 percent of the GDP.
  Source: 2006 U.S. DOE Buildings Energy Databook

Energy Consumption

- Buildings represent 39 percent of U.S. primary energy use (includes fuel input for production)

Electricity Consumption

- Buildings represent 70 percent of U.S consumption
  Source: 2003 U.S. DOE Buildings Energy Databook
Water Use
• Buildings use 12.2 percent of all potable water, or 15 trillion gallons per year

Materials Use
• Buildings use 40 percent of raw materials globally (3 billion tons annually)

Waste
• The Environmental Protection Agency (EPA) estimates that 136 million tons of building-related construction and demolition (C&D) debris was generated in the U.S. in a single year.
• Compare that to 209.7 million tons of municipal solid waste generated in the same year.
References


Occasional Paper No.10


References
Prof. Eliseo A. Aurellado, Certified Public Accountant (CPA), and Cluster Chair of Finance at AGSB, obtained his Ph.D. in Organization Development from the Southeast Asia Interdisciplinary Development Institute (SAIDI). He carries a Bachelors degree in Business Administration (Major in Accountancy), Magna Cum Laude, from the University of the East, and a Master of Business Administration (MBA) degree from the University of California, Los Angeles, where he was also a Beta Gamma Sigma Gold Key Holder. He was former President of PCIB Property Care, Inc, a subsidiary of PCIBank (now BDO)---a universal bank of which he was also First Vice President. He started his career with SGV & Co., CPAs, worked with DeLoitte Haskins & Sells, CPAs in New York and became Partner and Audit Director of RS Bernaldo & Associates. He is currently Chief Operating Officer and Vice Chairman of the Board of Metro Stonerich Corporation, a Triple A, ISO-certified construction company that caters to big developers such as Robinsons, SM and Ayala. His company has built megamalls, high-rise and medium-rise condominiums and office buildings, schools, hospitals, churches, warehouses, and residential units nationwide. Dr. Aurellado teaches courses in finance, accounting and strategic management and has been a member of panels hearing students’ defense of Strategic Management (STRAMA) papers.