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Quantifying the Hidden Benefits of High-Performance Building

TAMU Mays Business School Cooperative Study

Energy savings and other more tangible benefits of green or high performance building have long been apparent in business. Although some of these green building initiatives are costly to implement, tangible benefits alone may not offset the initial costs of the projects, especially when considering shorter time horizons. Fortunately, intangible benefits of green building also exist. Of these intangible benefits, improved productivity is a valuable factor. With even a modest improvement in productivity, the corresponding increase in firm value may make more green building initiatives worth the investment.

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Executive summary

Courtesy renjith krishnan

The tangible benefits of high performance or "green" building have long been apparent in business. Energy savings, lower operating cost, and reduced taxes are advantages which are relatively easy to measure and monetize. For example, when a company chooses natural day lighting to offset electric lighting, they can easily calculate the power cost avoided for lights—this is a relatively simple engineering and accounting calculation.

However, some of these initiatives may be costly to implement and tangible benefits might not offset the initial costs, especially when considering shorter payback horizons required in challenging times. Without including other benefits, the net present value (NPV) of many projects become negative, making them difficult for businesses to justify. Fortunately, *intangible* benefits also exist.

Unfortunately, intangible benefits are often difficult to measure and monetize. Thus, customers and designers struggle with how to value these "soft" benefits when deciding whether to adopt the initiatives. Do these intangible benefits represent a material value to the adopting organization?

One intangible benefit of high performance buildings often cited is improved employee productivity. Even with modest improvements in productivity—improvements as little as ½%-1%—many green building initiatives become NPV positive. Therefore, in many situations, the intangible benefits of green building initiatives clearly provide a material benefit to the adopting customer, making such building improvements financially valuable to the company as a whole. However, this approach requires adopting a whole life cost analysis considering operational costs as well as initial capital.

High Performance building

For the purpose of this report, the terms high performance and green building initiatives are used synonymously to mean those building projects consistent with the Leadership in Energy and Environmental Design (LEED) Certification standard developed by the US Green Building Council (USGBC). There are many other green building standards, but the LEED process enjoys a wider market share and is universally familiar to many in the real estate property markets.

The LEED building initiatives fall into five primary categories[1]:

- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere

- Materials and Resources
- Indoor Environmental Quality

For each category listed, there are several LEED certification credits that can be earned through specific improvement projects. Some examples include projects such as abundant daylighting, improved ventilation, more responsive thermal comfort and control, the use of renewable building supplies, the use of local building supplies, and recycling programs.

Intangible benefits of green building

Many studies suggest that green building projects provide a number of intangible benefits. Most of these benefits have been studied through experience with existing building projects and/or research. For example, "[a] Lawrence Berkeley National Laboratory study found that U.S. businesses could save as much as $58 billion in lost sick time and an additional $200 billion in worker performance if improvements were made to indoor air quality."[2]

A Canadian research study investigating the long term costs of green building suggested a balance between intangible benefits and tangible benefits: "Savings in health and productivity costs because of increased earnings, reduction in respiratory diseases, and higher employee retention made up 85% of total whole-life cost savings, with [the tangible] savings in energy, water and waste making up the remaining 15%."[3]

Some of the intangible benefits include improved health of building occupants, improved company brand equity and goodwill, reduced environmental impact, and improved occupant comfort and productivity. Although this research team contacted several private companies to participate in this study, all declined. From candid discussions, we conclude that the benefits do exist, as evidenced by their adoption. We suggest that firms do not advertise these intangible benefits because they may identify these as closely held strategic benefits.

Improved health of occupants

Green building provides substantial health benefits to occupants due to improved indoor air quality (IAQ) which may be associated to LEED credits. For example, Fisk and Rosenfeld suggest that financial benefits resulting from improved occupant health from more efficient air filter upgrades, may exceed the incremental costs of the new filters by a factor of twenty.[4] Additionally, a CenterCore Inc. case study of IAQ and employee productivity, based on owner-provided sickness records, showed that a 94% increase in air quality resulted in a 40% self-reported increase in employee productivity.[5]

Most recently, Carnegie Mellon's E-bids research project showed that total productivity and health savings from "…providing half of the U.S. workforce with mixed-mode conditioning or natural ventilation is over $118.9 billion annually" [6] while total savings from "providing high performance electric lighting to 50% of U.S. workforce is only $49.1 billion annually."[7]

Improved company brand equity and goodwill

Given that consumers are five times more influenced by a corporation's environmentalism than they were a decade ago, businesses "almost have to go green to retain and grow their customer base" says Robert Passikoff, founder of Brand Keys.[8] Such influence by consumer demand has prompted LEED to target businesses by stating that "with certification comes a potential increase in ROI,

sales, customer satisfaction, employee satisfaction, and brand equity."[9] This may be especially true for firms seeking sales from the Millennial generation, whose traits are often cited as concerned with environmental issues.

There is a wealth of research that supports the USGBC claims. According to a Deloitte survey of businesses that had implemented at least one LEED retrofit, 100% of respondents saw an improvement in goodwill/brand equity.[10] CBRE's report, *Do Green Buildings Make Dollars and Sense?* found that "public image and recruitment of and retention of employees, are enhanced in green buildings."[11] While there is a need for further research in this area, most indicators suggest that companies can improve their image and thereby sales by going green. Further evidence of this is the occurrence of words related to sustainability in companies' corporate social responsibility websites.

Courtesy prozac1

Reduced environmental impact

According to the EPA, buildings account for 39% of the nation's total energy use, 68% of total electricity use, 12% of total water use, 38% of total CO2 emissions, and 60% of total non-industrial waste generated.[12] Although the monetization of environmental impacts in the USA trails UK and other EU countries, there is growing evidence that going green makes financial sense.

Many organizations that have implemented green building initiatives find that simply the process of evaluating their current processes identifies waste, drives improvements, and saves money. These companies found improvements to their triple bottom line, a metric that measures economic, environmental, and social performance. [13] Boeing's "Green Lights" program decreased its lighting electricity use by up to 90%, Pennsylvania Power & Light's lighting system upgrade resulted in energy savings of 69%, and West Bend Mutual Insurance's new building led to a 40-percent reduction in energy consumption per square foot.[14]

According to USGBC, "If half of new commercial buildings were built to use 50% less energy, it would save over 6 million metric tons of CO_2 annually for the life of the buildings—the equivalent of taking more than 1 million cars off the road every year."[15] Although the US markets have not yet valued a ton of CO_2, the cost of energy saved is very tangible.

Improved occupant comfort and productivity

One of the most lucrative impacts of green building suggests gains from improved employee productivity. Research shows that health and productivity cost savings to individual businesses average approximately 85% of the company's whole life cycle savings - aggregating these costs to a national level is staggering.[16]

In fact, the U.S. Department of Energy and Lawrence Berkeley National Laboratory's 1997 study projected that $12 to $125 billion was lost each year as a result of reduced employee productivity.[17]

Meanwhile, ASHRAE reported a loss to American businesses in 1999 of approximately $60 billion due to diminished productivity associated specifically with poor [Indoor Environmental Quality] (IEQ).[18]

Carnegie Mellon's E-bids research project states that a total savings of $52 billion annually can be "achieved by providing 35% of the U.S. workforce with effective daylight in workspaces."[19] Several research papers have shown gains of 6-26% increases in "occupant performance" in various groups, such as learning of students in schools, workers in commercial offices, or spending of consumers in retail venues.[20]

Although LEED credits cover multiple areas of green building, only 24% of the LEED points actually deal with health and productivity.[21] To date, most research linking productivity gains to LEED credits has been done on lighting.

The relationship between green building and productivity

According to the Whole Building Design Guide, a program of the National institute of Building Sciences, the magnitude of annual costs in private sector offices are on the order of $200 per square foot for salaries, $20 per square foot for building costs, and $2 per square foot for energy use. Many cite this 100:10:1 ratio when conducting life cycle assessments. Thus, "an additional $2 per square foot per year for brick and mortar costs [i.e. green building initiatives] would pay for itself if it generated a modest 1% increase in productivity."[22]

Although the amount of research is limited at this time, the results are consistent. Specific, valid, and reliable research shows a positive effect on productivity from three green building initiatives (as of this writing): improved day lighting, improved thermal comfort, and improved ventilation.

Courtesy Sura Nualpradid

Day lighting research

Scientists link productivity gains to improved lighting conditions, whether as a result of artificial lighting or natural lighting via day lighting. A Herman-Miller case study produced a 7% increase in worker productivity corresponding to a move to a green, day-lit facility.[23] Meanwhile, the Reno Post Office's implementation of improved lighting resulted in an 8% increase in productivity.[24]

Research shows that if "only half of people's" work involves tasks likely to be significantly influenced by practical variations of lighting, the range of performance improvement would be 1% to 10% [half of the original 2% to 20% finding]."[25]

Carnegie Mellon acknowledges day lighting as "the use of direct, diffuse, or reflected daylight to provide full or supplemental lighting for building interiors," which can

result in higher occupant satisfaction and motivation.[26] According to its ongoing E-bids project, Carnegie Mellon has identified a range of 0.45-40% in productivity gains from increased day lighting.[27] In fact, the E-bids research includes eleven studies which have demonstrated that "innovative day lighting systems can pay for themselves in less than one year due to energy and productivity benefits."[28] This study showed a 0.7-26% range of productivity gains and found that "twenty-five other studies have also shown that high performance lighting systems can pay for themselves in less than one year due to energy, productivity and health benefits."[29]

Thermal comfort research

Thermal comfort seems easy enough to address until one considers that individuals have drastically different temperature preferences. According to ASHRAE, thermal comfort is reached when "environmental conditions satisfy 80% of office occupants."[30] Conditions affecting thermal comfort include room temperature radiant temperature, air velocity, and relative humidity.

According to Simon Turner, president of Fairfax, VA-based Healthy Buildings International, "study after study shows that a building owner's greatest expense isn't equipment or operating costs, but losses in occupant productivity."[31] According to one study of an insurance office, the addition of individual temperature controls resulted in productivity gains of approximately 2-7%.[32]

Ventilation research

Studies suggest that making people happy with air quality results in productivity increases. The E-bids project shows productivity gains ranging from 3-18% and claims, "eight studies have shown that natural ventilation and mixed-mode systems can pay for themselves in less than one year due to energy and productivity benefits."[33]

Fisk identified eight studies that reported "23% to 76% reductions in acute respiratory infections among building occupants due to higher ventilation rates, reduced space sharing, reduced occupant density, or irradiation of air with ultraviolet light."[34] Short-term absences decreased in another study by 35% due to increased ventilation rates.[35] According to the Kats report, titled "The Costs and Financial Benefits of Green Building," the range of productivity improvement from improved ventilation was estimated to be 0.5% to 11%. [36]

Mixed initiative research

In 2002, Fisk stated that potential U.S. savings or productivity gains resulting from "improved worker performance from changes in thermal environment and lighting" could range from $25-180 billion.[37] Overall research has shown that "increases in tenant control over ventilation, temperature, and lighting each provide measured benefits from 0.5% up to 34% -- with average measured workforce productivity gains of 7.1% with lighting control, 1.8% with ventilation control, and 1.2% with thermal control."[38]

Given that employee labor costs significantly outweigh other operating costs for most U.S. businesses, marginal improvements to employee productivity can more than justify the costs of implementing green building initiatives. Recall the 100:10:1 ratio previously mentioned.

Productivity decay and synergy

Two factors that may tend to affect the productivity improvement over time include decay and synergy. Decay is the phenomenon that over time, any productivity improvement from any initiative will decline. People tend to get use to and grow to expect the environment. Synergy suggests that when we combine the effects of multiple initiatives the net effect is not simply a summation.

Decay

Some believe that the Hawthorne Effect may apply to green building benefits. This suggests that impacts will diminish over time as occupants become accustomed to the changes and return to their normal output. However, there is also some research to the contrary. In a review of 38 general studies consisting of Hawthorne and normal control groups, "no evidence was found.[39] The review specifically stated that "the mean effect associated with Hawthorne manipulation was non-significant and such groups could essentially be regarded as no different from no-treatment controls."[9] However, because of the minimal amount of research specific to green buildings in this area, and to be conservative, decay should be considered.

Synergistic effects

Similar to decay, little research has been done on the synergistic effects on productivity of combining multiple green building initiatives. However, according to Scot McClintock at Faithful+Gould, in value engineering studies, a common rule is often suggested. He recommends the "1/n" rule or in other words, each additional benefit is discounted by 1/n where n is the indexed number of each benefit.

For example, let's assume three improvement projects with expected productivity improvement gains of 5%, 2% and 1% respectively, when considered alone. The rule says that the full 5% benefit is realized for the first project (5% x 1/1), but the second benefit must be divided by 2 (2% x 1/2), and the third by 3 (1% x 1/3 , providing a total benefit of 6.33% (5% + 1% + 1/3) instead of adding 5% + 2% + 1% = 8%. The benefits are considered in descending order of potential advantage, meaning that the projects with the largest benefit are taken first.

Energy modelers can more accurately calculate these synergies on energy improvement projects recommended in energy audits, by calculating each improvement separately, and then also cumulatively.

One could make more aggressive or more conservative assumptions based on their risk preferences and/or understanding of the specific projects they are considering. C*aution* is encouraged when accepting these assumptions.

Valuing productivity improvements

Up to this point, we have referred to productivity improvements only in percentage terms. However, in order to use this information in a financial analysis, we need to determine the value these improvement represents. Because intangible benefits are not easily seen and understood, they are notoriously difficult to value. Productivity is no different. Fortunately, the value of productivity is a subject that has been widely researched in the fields of Industrial and Organizational Psychology, Management, and Organizational Behavior.

All paid employees represent a cost to their employer. Productive employees accomplish more work. Fewer employees or more work means better value and lower costs.

Incremental improvements in revenue represent values larger than an equal percentage reduction in cost for a profitable company. For example, a 5% improvement in one person's sales is worth more than a 5% reduction in the salesperson's salary, assuming the employee is already selling more than his cost of his wages. Since the goal of most businesses is to operate at a profit, revenue is generally some multiple of cost. Thus, using revenue to value productivity improvement is more meaningful than using costs. Considering only cost savings is much easier to estimate, but often is too conservative an approach.

In order to value productivity improvements, information about the mean and standard deviation, ($SD_{y)}$, for the performance distribution is needed. Below is an excerpt from Cascio and Boudreau's "Investing in People" regarding methods of determining SD_y for valuation:[40]

- 40 percent rule -- Multiply the average total remuneration of the group by 40%.
- Global estimation -- Value an average employee, an 85th percentile employee, and a 15th percentile, and calculate the differences between their estimates.
- CREPID -- Identify ranking, weighting and sum to get a monetary value for each individual. Calculate the standard deviation of those values across individuals.
- System effectiveness technique -- Estimate the percentage difference in performance effectiveness between a superior and an average performer, and multiply that percentage by the cost of the system and capital used on the job.
- Superior equivalents technique -- Estimate how fewer employees would be required to achieve a level of performance and determine the employment-cost savings of having superior versus average employees.

For purposes of a model, these valuation methods require significant customer and staff information be readily available. Because most of the five methods for valuation above require detailed information we decided to consider a simpler alternative approach for estimation.

The 40% rule states that the standard deviation of productivity, in dollars, of a job is equal to roughly 40% of the salary paid for that job. The 40% rule suggests that the value of improved productivity follows a normal distribution; or, that the difference in value between a 1% improvement and a 2% improvement is smaller than the difference in a 4% improvement and a 5% improvement.

For calculation of the productivity improvement value in the model—discussed in the following section—the distribution curve was replaced with a straight line approximation. This method again provides a more *conservative* estimate than the 40% rule for the value of improved productivity and has the advantage of not requiring any more information from the customer than the average salary. We assume, for example, that a 5% improvement in productivity is simply equal to 5% of the employee's salary. This straight line approximation also provides surprisingly similar results to the 40% rule while being much easier to implement.

Valuation Model

As part of this study, the team created a quantitative tool to estimate the benefits. The model is maintained in a Microsoft Excel workbook.

For each selected green building initiative category, we analyze the following information:

- Percentage of employees at the project site that will be affected
- A rating of the physical surroundings pertaining to that initiative, based on the user's own assessment, on a scale of 0 to 10
- Information about any marginal upfront costs expected

The user then enters the following broader project data:

- The average salary at the proposed project site
- The number of employees at the proposed project site
- The cost of capital for the project
- Additional, project-level upfront costs, if applicable

Finally, the model requires that the user select an expected project life, as well as values for the benefit decay and synergy parameters suggested earlier. Once we enter the required information, the model generates productivity benefit values which are displayed as separate outputs within the workbook. Additionally, the user will have the ability to run summary reports containing all valuation results and the sensitivity analyses.

Model assumptions

Cost of capital

For purposes of present value calculations, we select a cost of capital to discount the projected productivity benefits. The user will choose a cost of capital commensurate with the risk level for the project being evaluated. In a number of cases, the firm's overall cost of capital may be appropriate.

Nonetheless, the user selects a rate based solely on their own analysis as the model does not suggest a range of possible values. Indeed, the choice of a discount rate will be very contextual; therefore, we built the model to accommodate any discount rate that the user deems appropriate. Discount rate guidelines generally accepted among finance practitioners may be used in selecting the appropriate rate. Sensitivity analysis around the chosen discount factor is provided.

Client specific information

The user inputs the number of employee headcount, average salary at the project site as well as the percentage of those employees that are expected to be impacted by each initiative. Research suggests that green building initiatives may affect employees at the site differently due to site-specific, client-specific, or even industry-specific factors. For example, the effect of day lighting may vary based on the employee's location within the building, the present level of day lighting, or even the average employee's total time spent in the building. This may be especially relevant for mobile professions who spend less full time in the building, versus administrative functions that tend to be full time on site. This client-estimated information is incorporated into the model to generate more

accurate valuations. Since, due to context, the research on productivity provides a range of values of improvement, the user's estimate of present conditions allows the calculator to estimate where in the improvement range the expected benefit lies.

Future steps

Based on our research, we determined a number of "next steps" which should be considered for advancing this project. These include:

- Monitor and add new research -- As new research on productivity and LEED green building initiatives is performed, the model should be updated. This will both expand the capability of the model as well as ensure that the model remains current and relevant. Research in this area reaches across disciplines and is in its infancy, so monitoring new research is essential. Larger companies may wish to consider studies specific to their own employees before and after initiatives are undertaken.
- More research specifically on decay and synergistic discounts -- Our group made some educated assumptions about these two factors, but, we were unable to find sufficient and suitable research on the topic. The limited research we found suggested that decay was not present. Furthermore, we could find almost no relevant information about the synergistic effects on productivity from combining multiple green building initiatives. These two issues could have a large impact on valuation.
- Vet model on a real project -- To date, the model has only been used in a hypothetical setting. While the theory behind the model is sound, verifying the model's functionality on a real project is recommended to provide confidence and reliability.
- Consider expanding the scope of this research -- The model centers around productivity improvement. There are numerous other intangible benefits associated with green building initiatives that we were unable to capture in the valuation model. With time and more research, the model could be expanded to incorporate those benefits as well.

Appendix

Exhibit 1. LEED credits

LEED for New Construction and Major Renovation 2009
Project Scorecard

Project Name:
Project Address:

Yes	?	No			
			Sustainable Sites	**28**	**Points**
Y			Prereq 1 **Construction Activity Pollution Prevention**	Required	
			Credit 1 **Site Selection**	1	
			Credit 2 **Development Density & Community Connectivity**	5	
			Credit 3 **Brownfield Redevelopment**	1	
			Credit 4.1 **Alternative Transportation,** Public Transportation Access	6	
			Credit 4.2 **Alternative Transportation,** Bicycle Storage & Changing Rooms	1	
			Credit 4.3 **Alternative Transportation,** Low-Emitting & Fuel-Efficient Vehicles	3	
			Credit 4.4 **Alternative Transportation,** Parking Capacity	2	
			Credit 5.1 **Site Development,** Protect or Restore Habitat	1	
			Credit 5.2 **Site Development,** Maximize Open Space	1	
			Credit 6.1 **Stormwater Design,** Quantity Control	1	
			Credit 6.2 **Stormwater Design,** Quality Control	1	
			Credit 7.1 **Heat Island Effect,** Non-Roof	1	
			Credit 7.2 **Heat Island Effect,** Roof	1	
			Credit 8 **Light Pollution Reduction**	1	
Yes	?	No			
			Water Efficiency	**10**	**Points**
Y			Prereq 1 **Water Use Reduction,** 20% Reduction	Required	
			Credit 1.1 **Water Efficient Landscaping,** Reduce by 50%	2	
			Credit 1.2 **Water Efficient Landscaping,** No Potable Use or No Irrigation	2	
			Credit 2 **Innovative Wastewater Technologies**	2	
			Credit 3 **Water Use Reduction**	2 to 4	
			30% Reduction	2	
			35% Reduction	3	
			40% Reduction	4	
			Energy & Atmosphere	**35**	**Points**
Y			Prereq 1 **Fundamental Commissioning of the Building Energy Systems**	Required	
Y			Prereq 2 **Minimum Energy Performance:** 10% New Bldgs or 5% Existing Bldg Renovations	Required	
Y			Prereq 3 **Fundamental Refrigerant Management**	Required	
			Credit 1 **Optimize Energy Performance**	1 to 19	
			12% New Buildings or 8% Existing Building Renovations	1	
			14% New Buildings or 10% Existing Building Renovations	2	
			16% New Buildings or 12% Existing Building Renovations	3	
			18% New Buildings or 14% Existing Building Renovations	4	
			20% New Buildings or 16% Existing Building Renovations	5	
			22% New Buildings or 18% Existing Building Renovations	6	
			24% New Buildings or 20% Existing Building Renovations	7	
			26% New Buildings or 22% Existing Building Renovations	8	
			28% New Buildings or 24% Existing Building Renovations	9	
			30% New Buildings or 26% Existing Building Renovations	10	
			32% New Buildings or 28% Existing Building Renovations	11	
			34% New Buildings or 30% Existing Building Renovations	12	
			36% New Buildings or 32% Existing Building Renovations	13	
			38% New Buildings or 34% Existing Building Renovations	14	
			40% New Buildings or 36% Existing Building Renovations	15	
			42% New Buildings or 38% Existing Building Renovations	16	
			44% New Buildings or 40% Existing Building Renovations	17	
			46% New Buildings or 42% Existing Building Renovations	18	
			48% New Buildings or 44% Existing Building Renovations	19	
			Credit 2 **On-Site Renewable Energy**	1 to 7	
			1% Renewable Energy	1	
			3% Renewable Energy	2	
			5% Renewable Energy	3	
			7% Renewable Energy	4	
			9% Renewable Energy	5	
			11% Renewable Energy	6	
			13% Renewable Energy	7	
			Credit 3 **Enhanced Commissioning**	2	
			Credit 4 **Enhanced Refrigerant Management**	2	
			Credit 5 **Measurement & Verification**	3	
			Credit 6 **Green Power**	2	
Yes	?	No			

Exhibit 2. Example case study

Ivory Coast Legal Associates (ICLA) is a corporate law firm headquartered in Abidjan, Ivory Coast with operations in five countries including the United States.[a] The firm is looking to remodel its office building located in Miami, Florida and is considering various green building initiatives. ICLA's construction consultant, Faithful + Gould, has suggested that certain green initiatives will provide "soft" benefits that will result in increased monetary payback that would not be considered in a typical return on investment calculation. ICLA is considering incorporating daylighting shelves into the remodel as well as implementing a revolutionary individual thermal comfort control system. Faithful + Gould engineers have quantified the tangible benefits of these two initiatives. Moreover, they have provided ICLA a model that estimates the monetized intangible benefits that result from the productivity improvements that have been proven to result from such green building. The inputs and results of the ROI model follow:

ICLA's site in Miami houses 40 employees including attorneys, receptionists, and legal clerks. The average salary of those 40 employees is $85,000. In addition, the company's calculated cost of capital for that office is 12%. ICLA leadership believes the rating for their current thermal comfort system to be a 5. On the other hand, due to the age and style of the building, its daylighting rating is a dismal 2. Around 1/4 of its employees would not have access to the thermal control system and only half of the staff sits near the exterior of the building where daylighting would have an impact. Finally, ICLA expects these aspects of the remodel to last 15 years and the productivity effects to decay by 5% per year. They accept Faithful + Gould's default assumptions regarding synergistic discounts. See Exhibit 3 for a snapshot of the model's input table for Ivory Coast Legal Associates.

Finally, ICLA chooses not to incorporate any marginal cost estimates related to the green initiatives into the ROI calculation. Instead, they seek to know how much they could potentially spend on the thermal comfort system and daylighting without reducing firm value. Given the company inputs, Faithful + Gould's model estimates a lifecycle present value (without considering cost) of $1,325,592. The possible gross PV range given the applicable research evidence is between $462,588 and $1,860,785.[b] The various sensitivity tables included in the model show the possible results if ICLA's inputs varied slightly. For instance, the target gross PV would be just $1,130,316 if it assumed a cost of capital of 15% and only a 12-year life cycle. On the other hand, if ICLA chose the least conservative synergistic discount assumption and only a 2% annual decay, the target NPV would be $1,686,273. See Exhibit 4 for a snapshot of the model's outputted report for Ivory Coast Legal Associates.

For their purposes, ICLA could be confident that any spend less than $463,000 on the two initiatives would result in monetized intangible benefits greater than the associated cost. Furthermore, evidence suggests that the potential benefits could provide up to $1.4 million in additional value above the minimum. This does not take into account any associated tangible benefits.

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[a] This company is entirely fictional and by no means is meant to represent any actual organization.

[b] The minimum of the range assumes the lowest productivity improvement from the research coupled with the most conservative synergistic discount assumption. The maximum assumes the opposite.

Exhibit 3. Model client input page

FAITHFUL GOULD
CONSTRUCTIVE EXPERTISE

Client Inputs

Client: Ivory Coast Legal Associates
Date: 11/29/2010 14:22

Ventilation:

Will you be adopting an increased ventilation system?	N
If so, what % of employees will be affected by the improvement?	1%
Based on a scale of 0-10, what would you rate the current level of ventilation?	10
Are there any related and marginal upfront costs to consider for this initiative?	$ -

Thermal Comfort Control:

Will you be adopting a system for increased Thermal Comfort Control?	Y
If so, what % of employees will be affected by the improvement?	75%
Based on a scale of 0-10, what would you rate the current level of Thermal Comfort Control?	5
Are there any related and marginal upfront costs to consider for this initiative?	$ -

Daylighting:

Will you be increasing Daylighting (Daylight and/or Views)?	Y
If so, what % of employees will be affected by the improvement?	50%
Based on a scale of 0-10, what would you rate the current level of Daylighting?	2
Are there any related and marginal upfront costs to consider for this initiative?	$ -

General Information:

What is the average Salary at proposed site?	$ 85,000
How many employees are at the proposed site?	40
What is your firms cost of capital?	12%

Are there any ADDITIONAL AGGREGATE marginal upfront costs to consider?	$ -

What is the expected lifecycle or length of benefit?	15	Years
Please select decay % per year	5%	

*Erosion of benefit is expected to occur; however, no research has proven that it exists. This is purely speculative.

Synergistic Effect Assumptions (Scale 1-5)	3

*1 assumes conservative views of Synergistic Effects, 5 assumes aggressive realization of benefits
**1 will have a lower NPV than 5

Create Report with Sensitivity Analysis

Exhibit 4. Selected portion of model output report

FAITHFUL+GOULD CONSTRUCTIVE EXPERTISE

ROI of Green Building Initiatives due to Productivity

Report Generated on: 10/15/2010

Ivory Coast Legal Associates

Proposed Initiative	Expected Cost	Prod. Improvement	First-Year Benefit	Project Life NPV
Thermal Comfort	$0	3.88%	$131,750	$673,882
Daylighting	$0	4.60%	$156,400	$799,963

Combined Total	**$0**		**$259,165**	**$1,325,592**
			Low	**High**
		Possible NPV Range	$462,588	$1,860,785

COMBINED SENSITIVITY TABLES

Synergistic Effects V. Cost of Capital

		Synergistic Effects				
		1	2	3	4	5
Cost of Capital	9.00%	$ 1,428,578	$ 1,474,983	$ 1,521,388	$ 1,567,793	$ 1,614,198
	10.00%	$ 1,362,418	$ 1,406,674	$ 1,450,930	$ 1,495,186	$ 1,539,442
	11.00%	$ 1,301,298	$ 1,343,568	$ 1,385,839	$ 1,428,109	$ 1,470,380
	12.00%	$ 1,244,726	$ 1,285,159	$ 1,325,592	$ 1,366,025	$ 1,406,458
	13.00%	$ 1,192,268	$ 1,230,997	$ 1,269,726	$ 1,308,455	$ 1,347,184
	14.00%	$ 1,143,538	$ 1,180,684	$ 1,217,830	$ 1,254,976	$ 1,292,122
	15.00%	$ 1,098,193	$ 1,133,866	$ 1,169,539	$ 1,205,212	$ 1,240,885

Synergistic Effects V. Life Cycle (Years)

		Synergistic Effects				
		1	2	3	4	5
Life Cycle (Years)	12.00	$ 1,191,651	$ 1,230,360	$ 1,269,069	$ 1,307,778	$ 1,346,487
	13.00	$ 1,213,959	$ 1,253,393	$ 1,292,826	$ 1,332,260	$ 1,371,694
	14.00	$ 1,231,388	$ 1,271,387	$ 1,311,387	$ 1,351,387	$ 1,391,386
	15.00	$ 1,244,726	$ 1,285,159	$ 1,325,592	$ 1,366,025	$ 1,406,458
	16.00	$ 1,254,650	$ 1,295,405	$ 1,336,160	$ 1,376,916	$ 1,417,671
	17.00	$ 1,261,739	$ 1,302,724	$ 1,343,710	$ 1,384,695	$ 1,425,681
	18.00	$ 1,266,485	$ 1,307,625	$ 1,348,765	$ 1,389,905	$ 1,431,044

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