THE METRICS OF SUSTAINABILITY, PROJ_MGT 448
Avoiding the Pitfalls of GIGO (Garbage In; Garbage Out)

Master of Project Management Program, Northwestern University
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Course Objective

Nowhere in the building industry has the demand for metrics been as loudly proclaimed as in the sustainability arena. The vocabulary of measurement includes terms like benchmarking, cost benefit analyses, life cycle assessments, carbon and water footprinting, sustainable return on investment, predicted energy and water use, etc.

While the adage, "You can't manage what you can't measure," is true, critical thinking is just as important as the metrics we measure. Just as when you punch numbers into a calculator, you must look at the output and ask "is this answer reasonable?" In this age of big data, we are often lulled into blind acceptance of electronic recommendations, whether it is internet-based research, energy models, or the readings of a light meter.

In this course we will explore common types of sustainability metrics, and test out various software programs with the goal of assessing which tools are appropriate under which circumstances and why. Guest speakers will share real life experiences with metrics and data.

The most important metric of all is arguably the success of our clients. How can the buildings we design and construct contribute to their bottom lines? Students will apply a set of metrics to a real or hypothetical project in a chosen industry sector. They will evaluate the sustainability imperatives for their client and choose metrics that align with those imperatives. Analysis in the form of interim assignments, a 10- page paper, and a presentation will take the place of a final exam.

This course will be geared to help you understand the goals of these metrics, the state of the tools currently in use and will help students to build a tool box of skills that can be applied in their projects as they engage in work in the building industry.

Course Requirements:

This course follows a lecture/lab format. Students are required to bring a laptop to class each week to download software for the labs. Since many of the programs are Windows based, your laptop must have a Windows operating system or a Windows operating system emulator.

While there is not an assigned text book, the instructor will assign readings from various sources, which students are expected to have read before class.

Week 1 - Introduction to Metrics and Carbon Footprinting & Corporate Social Responsibility Reporting

What is a carbon footprint and the greenhouse gas protocol? Where are carbon reductions regulated or voluntary? What is the value of a ton of carbon? Carbon Footprinting is one of the metrics shared in corporate social responsibility reporting. In this class you will learn basics of carbon and carbon equivalents, carbon footprinting, including Scope 1, Scope 2, and Scope 3 emissions, and how they are reported.

Lab: Complete an exercise with a carbon calculators to measure your own carbon footprint.

Week 2 - Indoor Comfort Parameters

Space assessments and post occupancy evaluations (POE) are diagnostic tools placed at opposite ends of the life cycle of a space; assessments are done to determine what alterations are necessary to the ongoing functionality of a space and POEs are done as a quality check to ensure the spaces are delivering on the intent of the design. In this class learn about the comfort parameters of temperature, humidity, air speed, acoustics, daylighting, electric lighting, and carbon dioxide levels. Learn about baseline standards that define these comfort parameters and the difference between objective results (metered) and subjective results (surveyed).

Guest Instructor: Lois Vitt Sale, Wight & Company
Lab: Complete an occupant survey and assessment of the lecture classroom and adjacent spaces.

Week 3 - Predicted Energy Use

At some point in time, most organizations will build or renovate a building. Architecture 2030 estimates that the contribution to greenhouse gases from buildings is 48%. Fossil fuel extraction is becoming increasing complex, energy-intensive, and expensive. There is therefore an environmental, economic, and human health imperative to increase energy efficiency. In order to meet increasingly stringent energy targets required by building codes, designers must evaluate the energy implications of every design decision at every stage of the design process. Conceptual energy modeling can inform massing, orientation, window to wall ratio, and daylighting; choices that are easy to implement during concept design, have minimal to positive effects on cost, and significant impacts on energy use. In this class you will learn modeling methods and how to interpret the results.

Guest Instructor: Drew Morrison, seventhwave
Lab: Use a simple online conceptual modeling tool and software used by architectural firms to test scenarios of a sample building.

Week 4 - Benchmarking & Existing Building Energy Use Reduction

The US Department of Energy and Environmental Protection Agency have developed tools to measure energy use and developed labels for products that use less - water and energy. The American Institute of Architects launched the 2030 Commitment to report progress toward the Architecture 2030 Challenge, and several cities, including Chicago, legislated energy benchmarking ordinances to promote transparency in building energy use. In this class, we will discuss what labeling can achieve, and what the value of large-scale data collection is to being able to benchmark performance. Students will learn how to get a new construction project the Energy Star label, as well as register projects in Energy Start Portfolio Manager.

Guest Instructor: Rand Ekman, HKS
Lab: Calculate Energy Use Intensity for your residence and compare to a typical home (homework). Practice with Energy Star Portfolio Manager.

Week 5 - Waste Auditing

In this class you will learn how to conduct a solid waste audit and how to build a waste management plan with ongoing reporting to benchmark waste diversion. Included in this class will be a review of what material streams can be diverted,

what contents of our landfills are by percentage of waste materials, and how to build and manage a program for occupant recycling. You will see how waste auditing successfully promotes waste reduction in a large commercial building.

Guest Instructor: Martin Brown, Delta Institute
Lab: Conduct a waste audit in class.

Week 6 - Materials Transparency & Life Cycle Assessment

There is a new movement afoot, driven largely by the Federal government, US Green Building Council and the Living Building Challenge, to ask manufacturers to disclose the ingredients in the products purchased and installed in the built environment. Manufacturers claim they can't disclose the contents of their products to protect their competitive advantage; environmentalists believe the chemicals in those products may be harmful to humans and the environment. Learn about product declarations and discuss reporting requirements, and where the line on proprietary information should be drawn.

Wikipedia defines life cycle assessment (LCA) as "a technique to assess environmental impacts associated with all the stages of a product's life from-cradle-to-grave (i.e., from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling). Learn about material streams and terms such as cradle-to-gate, cradle-to-grave and cradle-to-cradle. Hear about the state of the art or science of life cycle assessment tools and how the demand for tools has long lagged behind the need for them in the green building industry.

Guest Instructor: Leonard Sciarra, Gensler
Lab:
Find and evaluate manufacturers' Environmental Product Declarations (EPDs) and Health Product Declarations (HPDs), and interpret the reported information with respect to human and environmental health.

Research completed life cycle assessments and analyze the reports on selected products. Practice with life cycle assessment software for products and buildings.

Week 7 - Occupant Wellness & Productivity

Most green building certification standards focus on resource efficiency more so than occupant health. The WELL Building Standard asks how can building design and operations positively impact the wellness and productivity of building occupants? This standard was developed through a collaboration between the building profession and medical profession and strives to quantify wellness metrics. Students will explore wellness metrics and projects that have successfully implemented wellness strategy.

Guest Instructor: John Mlade, WSP
Lab: Review assigned case studies of WELL certified buildings and report back to fellow students. Discuss how this standard differs from others that are more building focused.

Week 8 - Water Footprinting

Water is used in buildings for drinking, bathroom fixtures, processes, cooling tower makeup, and for irrigation. How can we protect this non-renewable, scarce resource that is often treated as a nuisance when it leaves a building? In this class we will explore water flows into and out of an organization or project. You will learn the basics of water footprinting, including water balancing for a project.

Guest Instructor: Deeta Bernstein, Cotter Consulting
Lab: Use a calculator to measure your own water footprint. Practice with LEED calculators indoor and outdoor water use. Calculate a water budget and size a rainwater cistern.

Week 9 - Zero Energy/Zero Water/Zero Waste

Triple net zero, is it achievable? Who is asking for it? Is anyone actually achieving net zero and if so how? The federal

government, specifically, the US Department of Defense has names triple net zero goals for some of their installations. What is the value of triple net zero and what are the outcomes of trying to achieve this aggressive goal? Students will research projects seeking net zero goals and report out on how those projects are faring toward reaching and/or maintaining net zero – of one or all three areas: energy, water and/or waste.

Guest Instructor: Lindsay James, Chrysalis Strategies
Lab: Review assigned case studies of net-zero buildings and report back to fellow students. Determine the viability of adding photovoltaics to t project. Calculate renewable energy potential with PV Watts.

WEEK 10 – Presentations

Each student will give a 5-7 minute presentation of highlights from their final paper, and answer questions from instructors and classmates.

COURSE EXPECTATIONS

- Arrive on time and remain for the full duration of each class, including labs.
- Bring a laptop that can run Windows programs to class each week for lab work.

COURSE GRADE:

The course grade will consist of the following areas:

Class Participation, Labs, and Attendance, Canvas Dialogue	20%
Assignments/Quizzes	20%
Final Project: Case Study Paper	15%
Final Project: Final Paper	25%
Final Project: Presentation	20%

The Final Project will be completed In lieu of a final exam. See below.

Final Project: Applying Metrics to a Project

Your task is to align metrics with a company's values and sustainability imperatives. You will identify the unique environmental imperative for a company, and based on that information, determine which metrics are the most valuable to track. You will apply those metrics to a typical building construction project for that company, aligning the construction project with the overall company goals. You will choose a business sector to be used throughout the quarter. For the final paper you will apply energy metrics, and at least 2 other metrics used in class that address water, materials, and habitat (land, people, and/or biotic systems).

This project will be based on each student's original work. You may include information from other people's thoughts/work; however, that work must be cited, and excerpts from other people's work longer than one paragraph will not be accepted. Grades will be based on depth of thought and demonstration of understanding of metrics. Plagiarism will result in a failing grade.

Interim Deadline 1: Case Study

Research a Sustainability Plan or Corporate Responsibility Report for an organization in your chosen industry sector. Write a case study (3 pages maximum) that includes answers to the following questions:

- What is this company's unique contribution to the world?
- Which environmental imperatives are relevant to their industry and how has the company addressed them?
- What environmental initiatives could this company pursue that would make their customers more successful while remaining true to the company's unique contribution to the world?

Submit electronically by noon April 25th

Interim Deadline 2: Final Paper Metrics Parameters

For the company you've chosen, make a list of all the building types they need to conduct their business (i.e. manufacturing plant, retail store, etc.). Choose one of those building types, which you will analyze for you Final Project and research typical dimensions and number of floors for that building type. These dimensions should be approximate and assume a basic rectangular shape. Select a city for this building based on where company has locations.

Submit: Building Type, Dimensions, Number of Floors, and Geographic Location.

Submit electronically by noon pm May 9

Submit Final Paper (10 pages maximum)

For the building type you chose for Interim Deadline 2, which metrics would you choose to track for each building type and why? How do these choices align with the overall environmental imperatives for your company? Demonstrate your understanding of the nested system of building, company, and the success of its customers, and how metrics fit into that nested system.

Apply at least 3 metrics from the list below to address energy, water, materials, and habitat (land, people, and/or biotic systems). These metrics should align as closely as possible with the metrics discussed in the first part of the paper, but do not need to match exactly. One of the metrics must be energy analysis with either Sefaira or Planit Impact. Describe the results of your analysis and how they would influence your approach. What are your recommendations for continuous improvement?

Metrics/Tools (Choose 2)
Life Cycle Analysis of Product produced by chosen company – Sustainable Minds or Gabi
Building Life Cycle Analysis - Athena
Water Use Analysis; Baseline and Reduction (Indoor and Outdoor) – Tools from Water Lab and Planit Impact
Analysis of EPDs and/or HPDs for potential building products (Compare at least 3 products for 3 product types - 9 total)
Submit electronically by noon May 30th

Presentation: **Week 10 – June 6, 2018**
5-7 minutes plus Q&A
Present the highlights of your final paper. There will be a short question and answer period after each presentation.