

IE 585 SUSTAINABLE SYSTEMS ENGINEERING

FALL 2024

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Course webpage: <https://odtuclass.metu.edu.tr/>

Course time and place: TBD

Catalog description:

This course dwells on the fundamental forces that are expected to shape the industrial engineering in the near future. It is a mostly qualitative umbrella course that combines many diverse topics within a framework of industrial and systems engineering. Brief history of sustainability. Principles of sustainability. Industrial, economic, environmental, agricultural, and urban sustainability. Sustainable development. Environmental ethics. Systems view of sustainability. Techniques for modelling complex systems. Criticism and the more negative connotations of sustainability. Globalization and issues of the post-globalized world.

Course objective: At the end of this class, the students are expected to

- Be aware of the natural drivers of the sustainability efforts,
- Be familiar with related standards (e.g. ISO 14000, ISO 26000), important concepts/keywords (e.g. tragedy of commons, 3BL, LCA, carbon equivalent, take-back legislation, regulatory compliance, greenwashing, and etc.)
- Be aware of the most recent modeling and research efforts in sustainable operations management,
- Learn tools and techniques required to analyze and design sustainable systems (mainly around supply chains)

Course materials:

Textbook (recommended but not a must):

1. Bouchery, Y., C. Corbett, J. Fransoo, and T. Tan (eds.), “Sustainable Supply Chains: A Research-Based Textbook on Operations and Strategy,” Springer, Switzerland, 2017. (E-book available for purchase)

Cases (available at hbr.org):

1. Denend, L. and E. Plambeck, “Walmart’s Sustainability Strategy (A)”, Stanford Graduate School of Business Case, OIT-71A, 2007 (upt 2010).
2. Jose, P.D., and M. Rao, “The Water Wars: Colas and Sustainability in the Twenty-First Century”, Indian Institute of Management Bangalore Case (IMB 681), 2018.
3. Lee, D. and L. Bony, “Cradle-to-Cradle Design at Herman Miller: Moving Toward Environmental Sustainability,” Harvard Business School Case, 2009.
4. Gino, F., M. W. Toffel, and S. Van Sice, “FIJI Water: Carbon Negative?” Harvard Business School Case, 2013.

Reference Material:

1. Atasu, A. (ed), “Environmentally Responsible Supply Chains,” Springer, Switzerland, 2016.
2. Esty, D. C. and A. S. Winston, “Green to Gold,” John Wiley & Sons Inc., New Jersey, 2006.

Background: Basic math and economics
Familiarity with OM problems and solution tools

Grading: Evaluation of students will be based on

- Homework assignment(s) (3%)
- Mini Midterm (10%)
- Class participation + quiz (1) (7%)
- Case study reports (3) (15%)
- Final (40%)
- Project (25%)

Course Outline:

Week No.	Subject	Case/Assignment Due
1	Introduction	
2	Tragedy of commons; Life cycle assessment (LCA)	
3	LCA; carbon footprinting	
4	Carbon footprinting	Walmart's Sustainability Strategy (A) – Report due
5	Carbon footprinting	
6	Carbon tax; carbon trade markets; carbon offsets	
7	Carbon tax; carbon trade markets; carbon offsets; greenwashing	FIJI Water: Carbon Negative? – Report due
8	Green logistics; Green inventory	
9	Green inventory cont'd; green facility location	
10	Design for environment; product differentiation	Herman Miller – Report due
11	Market-driven sustainability	
12	Water footprinting; water stress; water crisis	The Water Wars – No report required (will have an in-class quiz on the case)
13	Closed loop supply chains & Service-based economy	
14	Social responsibility	

Project: Students are expected to submit a project report on a stream of literature (carbon, social responsibility, closed-loop, and etc.) (max. 8 pages). The report should contain at least 7 published articles related to the research stream.

For each paper, students are expected to

1. describe the problem setting studied,
2. list the research questions,
3. summarize the main findings, and
4. discuss contribution of the paper (to the literature) and its value to practice

The papers must be published in one of the following journals: Management Science, Operations Research, Manufacturing & Service Operations Management (MSOM), Production and Operations Management, European Journal of Operational Research, Omega – The International Journal of Management Science.

The list of journals can be relaxed upon consultation with the instructor.

Students can also introduce a *potential problem* that can be studied. This problem should be relevant and should promise a contribution to the literature. This problem part is optional and will be considered as a *bonus (up to 15% of the report grade)* if submitted. The more details about the problem setting, the better!

Case Write-ups: All case write-ups will be done in groups of two and will be due to the class scheduled for the discussion of the particular case. Case write-ups will be in the form of answers to the listed questions regarding the case (all listed on the next page).

The required format of case write-ups:

- Calibri, 11pt in MS Word with standard margins
- Concise and clear sentences
- No more than 5 pages
- Formal references where required

Case write-ups will be turn-it-in assignments. They cannot be submitted late.

Case Assignment Questions:

Walmart

1. How is Walmart deriving *business value* from its sustainability strategy?
2. Imagine that you are Andy Ruben or Tyler Elm, evaluating the progress of the electronics, seafood, and textiles networks. Which of these networks have been most successful in creating business value by reducing environmental impacts? *What factors explain the success or (lack of success) of these networks?*
3. How is Walmart motivating its suppliers to share information about and reduce the environmental impacts of products and processes?
4. Walmart's sustainability strategy has generally been profitable (as evidenced by Exhibit 9 in the case). However, at least one initiative described in the case benefits society and the environment, but apparently decreases Walmart's profits. Identify one or more such initiatives and imagine that you are the internal champion. How would you justify pursuing the initiative(s)?

FIJI Water

1. When the Resnicks acquired FIJI water in 2005, the bottled water industry was very crowded; even so, FIJI Water soon became a leading U.S. importer of bottled water. What accounts for FIJI Water's success?
2. Calculate the carbon footprint of shipping a metric ton (1,000 1-liter bottles) of FIJI Water to your location (make and clearly state your assumptions where necessary). How would you go about estimating the carbon footprint of a liter of tap water?
3. What is greenwashing, and why do companies engage in greenwashing? How can one tell when a claim constitutes greenwashing?
4. What is additionality? Do the tests for additionality make sense?
5. In light of the lawsuit, should FIJI Water amend its carbon negative strategy?

Herman Miller

1. Description of Herman Miller at the time of the case. What is cradle-to-cradle?
2. How has being "green" played a role in the company?
3. How "green" should Herman Miller continue to be as they move forward, and why? Specifically, PVC or TPU now and going forward, and why?

The Water Wars (only for preparation purposes for in-class discussion and quiz)

1. What are the risks faced by beverage companies over the usage of water? What could beverage companies do to mitigate these risks?
2. Define how beverage companies should deal with the issue of water, what key challenges do they face while dealing with the issue and what steps are they taking to address the issue?
3. Develop a strategy for a water intensive company to avoid conflicts. What (else) can Coca Cola and PepsiCo do? Summarize their recent water-related investments from their latest reports.