

## **Engineering Tripos Part IIA, 3E11: Environmental Sustainability & Business, 2017-18**

### **Module Leader**

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### **Timing and Structure**

Michaelmas term

### **Aims**

The aims of the course are to:

- Identify the practical challenges and opportunities facing businesses in terms of integrating sustainability into their operations and value chains.
- Critically examine the conceptual tools and best practices used to prioritize and deliver on improved environmental sustainability outcomes.
- Recognize that business sustainability requires systematic analysis coupled with prioritization of (sometimes incommensurable) aspects of the issues.

### **Objectives**

As specific objectives, by the end of the course students should be able to:

- Apply systems thinking, lifecycle assessment, and other frameworks to business sustainability problems.
- Be able to be critical consumers of sustainability metrics, reporting and information in their business and personal lives.

### **Content**

In this course, we will explore the challenges and opportunities presented for businesses attempting to integrate more environmentally sustainable practices. Much of the work done today in service of sustainability simply (though admirably) amounts to doing “less bad,” by, for example, reducing employee commuting, minimizing waste, or curbing carbon emissions. But sustainability demands fundamental realignment of business practices and system-wide innovation to radically reduce the ecological footprint of business to within planetary boundaries. Approaches and tools for managing environmental sustainability include those that help us think systematically about impacts, draw meaningful comparisons, and assess opportunities for change within a business’ own operations, its supply chain, and with partners. After taking this course, you will be able to help organizations integrate environmental sustainability into their operations and help them develop the more sustainable business processes and services of

the future.

### **Overview of Course Sessions**

Grasping the Extent and Nature of the Problem

Sustainability as a System Condition

Guest Lecturer on Business Sustainability

Can Commerce Mimic Nature? Circular Economy and Industrial Symbiosis

Industrial Symbiosis Case Analysis

Life Cycle Assessment

Driving Sustainability Efforts through Business Strategy

How Much is Enough? Supply Chain Sustainability and Accountability

### **3E11: ENVIRONMENTAL SUSTAINABILITY and BUSINESS**

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### **Course Content**

In this course, we will explore the challenges and opportunities presented for businesses attempting to integrate more environmentally sustainable practices. Much of the work done today in service of sustainability simply (though admirably) amounts to doing “less bad,” by, for example, reducing employee commuting, minimizing waste, or curbing carbon emissions. But sustainability demands fundamental realignment of business practices and system-wide innovation to radically reduce the ecological footprint of business to within planetary boundaries. Approaches and tools for managing environmental sustainability include those that help us think systematically about impacts, draw meaningful comparisons, and assess opportunities for change within a business’ own operations, its supply chain, and with partners. After taking this course, you will be able to help organizations integrate environmental sustainability into their operations and help them develop the more sustainable business processes and services of the future.

### **Course Aims**

Students will gain an understanding of the following key areas:

§ Identify the practical challenges and opportunities facing businesses in terms of integrating sustainability into their operations and value chains.

§ Critically examine the conceptual tools and best practices used to prioritize and deliver on improved environmental sustainability outcomes.

The skills gained in this course include fostering the ability to:

§ Apply lifecycle assessment and systems thinking to business sustainability problems.

§ Become critical consumers of sustainability metrics, reporting and information in their business and personal lives.

## **Requirements**

In order to maximally benefit from this course it is imperative that you come prepared for each lecture *by preparing the relevant readings and case studies as indicated in this document*. You will be expected to not only attend all lectures, but also actively participate in class discussions. When you actively participate, everyone benefits from a more positive learning environment and the class becomes more interesting and fun. You should also attend and prepare for supervisions. Each supervision is an essential element of the course.

## **Assessment**

Your grade will be determined by exam only. The exam will last for 1 ½ hours. There will be 3 questions of which 2 must be answered. In addition, you may choose to submit one piece of coursework. The coursework consists of an essay of 3,000 words. The topics for the essay will be announced in class.

## **Supervisions**

You will have 3 supervisions as part of this course. You will be asked to prepare an essay or written exercise for each supervision and be ready to discuss it with your supervisor and other students. Please refer to the end of this document for further details on the supervision sessions.

## **Overview of Course Sessions:**

Session 1: Grasping the Extent and Nature of the Problem

Session 2: Sustainability as a System Condition

Session 3: Guest Lecturer on Business Sustainability and Climate Change

Session 4: Can Commerce Mimic Nature? Circular Economy and Industrial Symbiosis

Session 5: Industrial Symbiosis Case Analysis

Session 6: Life Cycle Assessment

Session 7: Driving Sustainability Efforts through Business Strategy

Session 8: How Much is Enough? Supply Chain Sustainability and Accountability

## **Handouts**

In order to protect the environment, lecturers are encouraged not to disseminate hardcopies of the lecture slides, but rather to upload the slides in advance of each session. We hope that this arrangement will work well for you.

## Reading List

### General Reading

Each of these books offers valuable perspectives on business and environmental sustainability. Some of them cover a wide range of industries and/or materials, and should be treated as general references for those wishing to go deeper into a particular issue, for example for a supervision or coursework paper.

<b>Senge, P. et al. (2010)</b>	<i>The Necessary Revolution: How Individuals and Organizations are Working Together to Create a Sustainable World.</i> Crown Publishing	Library link
<b>Ehrenfeld, J. (2009)</b>	<i>Sustainability by Design: A Subversive Strategy for Transforming Our Consumer Culture.</i> New Haven, CT: Yale University Press	Library link
<b>Graedel, T. &amp; Howard-Grenville, J. (2005)</b>	<i>Greening the Industrial Facility: Perspectives, Approaches, and Tools.</i> New York, NY: Springer	Library link
<b>Allwood, J. M. &amp; Cullen, J. M. (2015)</b>	<i>Sustainable Materials - Without the Hot Air: Making Buildings, Vehicles and Products Efficiently and with Less New Material.</i> Cambridge, UIT Press.	All chapters at: <a href="http://www.uit.no">http://www.uit.no</a> [3]

### Detailed Reading

While readings under “required preparation” represent essential preparatory work prior to each class, there is no expectation that you will read literature marked as optional reading. The intention is to give you the option of reading more deeply on topics that interest you, and to provide with a taste of the academic literature that has pushed the field of business and sustainability research forward.

### Session 1: Grasping the Extent and Nature of the Problem

During the first session, we will explore the state of the problem, considering how business organizations both contribute to the current state of planetary health, and, importantly, must act within its constraints. We will consider recent trends and their implications for business operations, including resource availability, product/service shifts, and business models.

#### Pre-Assignment

Footprint calculations: using *either* <http://coolclimate.berkeley.edu/carboncalculator> [4] OR <http://footprint.wwf.org.uk> [5] calculate your personal/household carbon footprint.

[The two options use US or UK base cases/units; feel free to select another that works better for your situation; there are many other options and you are free to estimate your climate change footprint using one of these].

Required Reading

Figueres, C., Schellnhuber, H. J., Whiteman, G., Hobley, A., & Rahmstorf, S. (2017). Three years to safeguard our climate. *Nature*, 546(7660), 593-595.

Optional Reading

Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., ... & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, 347(6223), 1259855.

**Session 2: Sustainability as a System Condition**

In this session, students will form teams to play a simulation game that introduces ideas of systems dynamics and the 'tragedy of the commons,' two ideas that underpin the complexity of environmental sustainability issues and illuminate the inherent challenges to their resolution by business organizations.

Required Reading

Fishbanks Introduction (2 pages); handed out in class prior to simulation.

Optional reading:

Hardin, G. (1968). The tragedy of the commons. *Science*, 162(3859), 1243-1248

Dietz, T., Ostrom, E., & Stern, P. C. (2003). The struggle to govern the commons. *science*, 302(5652), 1907-1912.

Ehrenfeld, J. (2008). Sustainability by design. *A subversive strategy for transforming our consumer culture*. New Haven: Yale University. Chapter 2. pp. 11-21.

Sterman, J.D. 2012. Sustaining sustainability: creating a systems science in a fragmented academy and polarized world. In *Sustainability Science* (pp. 21-58). Springer New York.

**Session 3: Guest Lecturer on Business Sustainability**

Prof. Andrew J. Hoffman, Holcim (US) Professor of Sustainable Enterprise at the University of Michigan will speak on the topic of climate change and business responses, and share specific examples.

**Session 4: Can Commerce Mimic Nature? Circular Economy and Industrial Symbiosis**

We consider the intriguing premise of the circular economy/industrial ecology, which is the idea that industrial and commercial systems could mimic nature, where material resources are infinitely recycled and there is no such thing as accumulation of 'waste.' We will learn about model systems around the world that put the principles of industrial ecology, and industrial symbiosis (the direct exchange of waste or by-product between firms) into practice. These systems not only optimize resource use, but also lower carbon emissions as they reduce the need for the extraction or production of virgin materials.

What opportunities arise when managers start thinking differently about resources? What are the challenges to putting these kind of arrangements in place?

### Required Reading

Frosch & Gallopoulos, 1989. Strategies for Manufacturing. *Scientific American*. 7 pages.

### Optional Reading

Listen to the Industrial Waste segment at: <http://www.cbc.ca/whatawaste/episodes/2014/07/28/industrial-waste/> [6]

Boons, F., Chertow, M., Park, J., Spekkink, W., & Shi, H. (2016). Industrial symbiosis dynamics and the problem of equivalence: Proposal for a comparative framework. *Journal of Industrial Ecology*.

Chertow, M., & Ehrenfeld, J. (2012). Organizing Self? Organizing Systems. *Journal of Industrial Ecology*, 16(1), 13-27.

Paquin & Howard-Grenville 2009. Facilitating regional industrial symbiosis: Network growth in the UK's National Industrial Symbiosis Programme. In Boons & Howard-Grenville (Eds.). *The Social Embeddedness of Industrial Ecology*.

## **Session 5: Industrial Symbiosis Case Analysis**

We will discuss the Cook Composites & Polymers case. Can a toxic chemical by-product be made into a useful and saleable product? What are the environmental and economic benefits, and do these outweigh the risks? What recommendations do you have for managers at Cook Composites & Polymers?

### Required Reading – Case

*Please fully and carefully read the case prior to class and think about your position on the options posed. You will be expected to be ready to your ideas about the case itself, and the questions it raises, in class.*

Lee, D. Toffel, M. & Gordon, R. Cook Composites & Polymers, Co. Harvard Business School Publishing. Case # 9-608-055. Revised May 21, 2017.

## **Session 6: Life Cycle Assessment**

We will learn about managerial application of life cycle assessment (LCA), a methodology for assessing sustainability impacts of products or processes. Students will work on an in-class LCA exercise designed to show how sustainability impacts can be quantified and compared, and the assumptions and trade-offs that are inherent in such quantification and comparison.

### Optional Reading

Graedel & Allenby. 2009. Chapter 12: An Introduction to Life Cycle Assessment. In *Industrial Ecology and Sustainable Engineering*. Prentice Hall. pp. 161-173.

Graedel & Allenby. 2009. Chapter 13: The LCA Impact and Interpretation Stages. In *Industrial Ecology and Sustainable Engineering*. Prentice Hall. pp. 175-189.

Toffel, M. & Sice, S. 2011. Carbon Footprints: Methods and Calculations. Harvard Business School Publishing. # 611075. Revision date Dec 19, 2013. 15 pages.

### **Session 7: Driving Sustainability Efforts through Business Strategy**

Recent years have seen a virtual explosion in measurement, metrics and reporting on sustainability impacts by business organizations. But managers should be driven by smart sustainability strategy, not just the demands of reporting. In this session we will explore the state of sustainability reporting, with its recent emphasis on materiality (in brief: 'what matters' to a company), and how this can and should shape sustainability strategy.

#### **Required Reading – Case**

*Please fully and carefully read the case prior to class and think about your position on the options posed. You will be expected to be ready to your ideas about the case itself, and the questions it raises, in class.*

Eccles, R., Serafeim, G., and Armbrester, K. Tough Decisions at Marks and Spencer. Harvard Business School Publishing. Case # 9-112-062. Revised September 30, 2015.

#### **Optional Reading**

Eccles, R. G., & Serafeim, G. (2013). The performance frontier. *Harvard Business Review*, 91(5), 50-60.

SustainAbility (2014) See change: How transparency drives performance. Read the Executive Summary, the section on Materiality, and the section on Integration. About 16 pages.

### **Session 8: How Much is Enough? Supply Chain Sustainability and Accountability**

Using an in-class case discussion on the publishing company, Axel Springer, we close the course by exploring the boundaries of responsibility for sustainability practices. Is a digital media provider responsible for the conflict minerals in your smartphone? This example opens up the linked issues of social and environmental sustainability and also returns us to questions of how managers grapple with a world of systems – and to what degree they can influence sustainability impacts in the far reaches of their value chain.

#### **Supervisions**

To be announced.

#### **Biographical information:**

Dr. Jennifer Howard-Grenville is the Diageo Professor in Organisation Studies at the Cambridge Judge Business School. Her research is focused on how organizations manage change, particularly around environmental and social issues. Jennifer received her PhD at MIT, her MA at Oxford, and her BSc (Eng.) at Queen's University, Canada. She has taught extensively on management and business sustainability to MBAs, Executive MBAs, doctoral students and undergraduates.

## Further notes

Teaching Methods:

- Interactive lecture sessions
- In-class simulations and case discussions
- In-class exercises

## Examples papers

As this is a new elective this year, there are no example papers available, but guidance will be given on how to prepare for the final paper.

## Coursework

Details to be announced in lectures.

### [Coursework Title]

#### Learning objectives:

- Apply concepts and frameworks introduced in the lectures to a specific business opportunity/problem.
- Critically examine and discuss tradeoffs that arise in the solutions/proposal.

#### Practical information:

- The coursework will be an (optional) essay that will help students prepare for the final paper, as the question set will be similar to those encountered on the exam.
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#### Full Technical Report:

Students [will/won't] have the option to submit a Full Technical Report.

## Booklists

Please see the [Booklist for Part IIA Courses](#) [7] for references for this module.

## Examination Guidelines

Please refer to [Form & conduct of the examinations](#) [8].

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#### **Links**

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[2] <mailto:j.howard-grenville@jbs.cam.ac.uk>

[3] <http://www.withbotheyesopen.com/read.php>

[4] <http://coolclimate.berkeley.edu/carboncalculator>

[5] <http://footprint.wwf.org.uk/>

[6] <http://www.cbc.ca/whatawaste/episodes/2014/07/28/industrial-waste/>

[7] <https://www.vle.cam.ac.uk/mod/book/view.php?id=364091&chapterid=261762>

[8] <https://teaching.eng.cam.ac.uk/content/form-conduct-examinations>