

With the growing emphasis on sustainability in all industries, business students need ways to think critically about the environmental impacts of products and services. But too often, students' thoughts about environmental impacts begins and ends with recycling. To make meaningful contributions toward sustainability, management students need a more expansive understanding of the opportunities.

But management faculty often struggle to find learning experiences that help students learn to think critically about the environmental impacts of the industries they plan to enter. As a result, many of us miss opportunities to help students reflect more deeply on the environmental impact of the work they will do during their careers.

Life cycle assessment (LCA) is a basic tool used to identify environmental impacts, and to redesign products or services in order to mitigate those environmental impacts (US Environmental Protection Agency, 1993.). While brief LCA exercises can be found in a few business in society textbooks, (for example Hartman et al, 2008), I have not been able to find a process that non-specialist instructors could use confidently. This experiential exercise is intended to fill that gap.

A simplified LCA process focused on qualitative results can provide a useful introduction to the thought processes necessary to create more sustainable products and services. At the same time, it can challenge students' assumptions about how to address environmental problems. In this way, LCA provides a powerful framework for critical thinking about the types of changes to products and processes that will make the most difference.

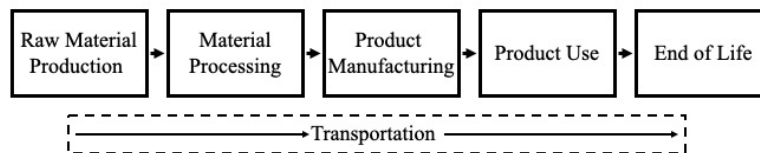
This exercise will prepare participants to introduce students to a simplified LCA process. It can also provide a useful starting point for discussions for broader topics, such as transitioning to a circular economy, or major changes within an existing industry.

Theoretical Foundation

LCA is a process for identifying the environmental impacts associated with each stage of a product's life. LCA can be used to prioritize the opportunities for improving an individual product. It can also be used as a way to compare the environmental impacts of two or more products.

LCA has proven valuable because it often identifies environmental impacts that are not obvious to the casual observer. A “streamlined” LCA framework (Graedel, 1998) explores the materials and energy used, and the environmental impacts created in each of five stages of the life cycle for a product or service:

Life Cycle Assessment



LCA provides the conceptual foundation for understanding key environmental management practices such as “cradle to cradle” design of products (McDonough and Braungart, 2002), and more recently, the “circular economy” (Stahel, 2016). The qualitative approach demonstrated in

this exercise provides a solid foundation for many emerging approaches to environmental management of business products and operations.

The exercise follows a constructivist approach to student learning (Bada, 2015).

Constructivist approaches ask students to apply concepts they already know and then confront challenges that require them to update those concepts as they encounter new challenges. The LCA exercise works with familiar objects and asks participants to discover and apply basic knowledge they already have and then to gather new knowledge to fill in gaps. The process typically requires students to think critically, by updating their existing mental models to solve new problems (Hamilton and Klebba, 2011; Smith, 2003) For example, students often assume that recycling is the appropriate response to an environmental problem, when often that is a tacit admission of a poor design or a poorly conceived product.

Learning Objectives.

After completing the exercise, participants will be able to conduct a classroom exercise with their students, focused on life cycle assessment. They will be prepared to help students:

1. Identify the most important environmental impacts from creating, using and disposing of a product.
2. Prioritize the most important environmental impacts associated with a product .
3. Recommend possibilities for reducing the environmental impacts associated with a product.

Logistics for the Experiential Exercise

The exercise is designed for a 75-minute conference session. If necessary, the exercise can be abbreviated to be completed in 60 minutes. Participants will conduct an abbreviated version of an LCA. The session will be conducted as follows:

Content	Time
Introduction and mini lecture	10 minutes
Exercise (divided as follows).	45 minutes
1. Identify key materials and select 1 to assess;	10 minutes
2. Identify key impacts of each life cycle stage for that material.	20 minutes
3. Prioritize 1 opportunity for reducing impact.	5 minutes
4. Identify at least one possible way to reduce the identified harmful impact.	10 minutes.
Debrief: Discuss participant’s learning from the exercise	10 minutes
Application: Discuss how to apply LCA in participant’s classrooms.	10 minutes

Working in teams of 3-4 people, participants will identify key materials, and then to identify the key impacts for one material. Appendix 1 shows the forms that we will use during the exercise, and which will be available for participants to tailor for use in their own classrooms. Appendix 2 describes the debrief process. Appendix 3 summarizes some key insights that students typically gain from the exercise.

This exercise asks participants to draw on their general knowledge but allows them to use search engines on their phones or computers to identify the sources of raw materials and specific impacts. Throughout the process, I remind students that we are looking for insights rather than trying to quantify impacts or be precise in our analyses.

Participants will not have detailed knowledge of product design processes, but can often readily imagine conceptually simple approaches, such as incorporating a recycled material into the construction of the product or reducing water or power usage during production.

Conclusion

The exercise helps participants reframe their understanding of opportunities for more sustainable business. Using familiar products, participants discover impacts that are often hidden in plain sight. In the process they reframe their understanding of business changes required in order to make real improvements (Smith, 2003).

With every product I have ever used in this exercise, students have been readily able to identify steps that could be taken to reduce the environmental impact of the product. This insight is important as a way to combat the often-mistaken belief that reducing the environmental impact from a product is costly and difficult (and therefore not worthy of management attention.)

For example, many students express concern about plastic pollution in the ocean, and reflexively propose ways to recycle more effectively. But an LCA indicates that the early life cycle stages for plastic contribute heavily to climate change. This realization helps students focus their thinking on ways to eliminate plastics wherever possible. Elimination of plastic would require serious engagement by product designers, procurement departments, and other parts of the business to achieve real change.

While there are many powerful entry points to thinking about sustainability in business, this exercise is particularly powerful because it helps students to see familiar objects in new ways. It also demystifies the process of improvement by highlighting the role of the business functions that they are already learning about in their business curriculum.

References.

Note: This proposal does not reference all of the references listed below. The listed resources are taken from a longer manuscript currently under development that explains the exercise in additional detail.

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Appendix 1: Key Tables to Use in the Exercise

Table 1 - Key Materials

Product:

Material	Source

Key Materials to Focus On:

Table 2 - Key Impacts

Life Cycle Assessment Product:

	Raw Material Extraction	Materials Processing	Manufacturing	Product Use	End of Life
Key Activities Material 1: Material 2:					
Key Environmental Impacts					

Note: If possible, format and print the handout of this table in landscape orientation.

Appendix 2: Debrief

Debriefing the exercise effectively requires limiting the information that each team reports out to keep them from getting lost in the details.

I ask each team to present the top two materials for their product, and then to identify one key environmental impact (and the specific stage in which it occurs) from one of those materials. Finally, I ask them to identify one improvement to reduce the key environmental impact they identified. I reinforce life cycle thinking by pointing to a summary life cycle slide and ask them to identify the life cycle stage(s) their improvement would affect.

After all teams have reported out, I typically ask them to identify what challenges they faced identifying the materials and the impacts. I also ask them what surprises they encountered. Students will typically be surprised by how little they know about the sources of materials, and the production processes for everyday products.

I conclude the exercise by asking students to reflect on how readily they could envision changes to a product to reduce harmful environmental impacts. When possible, I ask them to reflect on what role the particular business functions they intend to work in might have on decisions that might affect their company's environmental impacts.

Appendix 3: Insights from LCA Processes

Students are typically surprised at several discoveries they make during the LCA exercise. Often, students are surprised by the number of materials that go into common products. Students also often discover they did not know the origin of materials they use every day. In particular, they don't know where basic materials such as plastics, metals or fibers used in familiar products come from.

Students often discover impacts at life cycle stages they have not considered previously. For example, most students will think about preventing plastic pollution in the ocean, and will stress the importance of recycling. But much of the harmful climate impact occurs in the production of plastic, suggesting that no amount of recycling will address the underlying problem.

They discover that the most significant ways to reduce environmental impacts typically require changes in the early life stages of the product, rather than recycling products after they have been purchased and used. This discovery can shift their thinking about the business decisions that must go into product development.

Finally, students typically discover that despite their lack of detailed knowledge about materials and production processes, they can readily identify ways to mitigate important environmental impacts. Significantly, the changes that they envision are not simply engineering changes, but decisions to be made by business functions such as product marketing, procurement, design, and manufacturing.

The value in the exercise comes from grasping the concept that products have environmental impacts at all stages of their life cycle, and the most significant ones may be largely invisible to business decision makers and customers. At the same time, I prefer to emphasize that the

primary value of this approach is to increase confidence in their ability to make positive impacts, not to be bogged down in the complexity of the assessment.