Sustainable Product Development Initiatives in the Footwear Industry based on the Cradle to Cradle Concept

Jocelise J. Jacques - jocelise.jacques@ufrgs.br
Alice M. Agogino - agogino@berkeley.edu
Lia B. M. Guimarães - lia@producao.ufrgs.br
Outline

- Background: Cradle to Cradle Concept and other Approaches

- Why study shoes? Environmental Issues in the Footwear Industry

- Cases (American and Brazilian companies)

- Final Comments
Cradle to Cradle Concept

- Linear Flow - Cradle to grave -
  - Extraction of raw materials
  - Manufacturing materials/products
  - Packaging, transportation
  - Marketing

- Cyclic Flow - Cradle to Cradle -
  - Use, reuse and recycling
  - Safe disposal of waste

Extraction of raw materials
  - Biological metabolism
  - Technological extraction

Cradle to Cradle Concept Background

Background

Footwear

Cases

Final Comments
Cradle to Cradle Concept

Products must be designed so that, in the end of their service life, they can be reused or recycled without loss of quality - as technical nutrients, or be returned to the environment and safely decomposed - as biological nutrients.

(McDonough & Braungart, 2002)

- Industrial Ecology
  (Harper & Graedel, 2004)
- Industrial Metabolism
  (Ayres & Simonis, 1994)

✗ No
✓ Yes
Green products ≠ Sustainable products

- Products designed and produced in a conventional way, with only basic changes to the manufacturing process, may be referred to as “green” because they are less harmful to the environment than others.

  However, this does not mean that their production is sustainable.

- It’s typically easier to point out reasons why products are not sustainable, than to define all the attributes that would make a product so.

- It is fundamental to promote conceptual changes in the product development process as a whole, encouraging innovative solutions in product design and production.
Key Areas for Cradle to Cradle Design

- **Materials**
- **Water**
- **Energy**
- **Social Responsibility**

Reutilization of materials and End of Life
Why study shoes?

- Shoes satisfy a **basic human need** that is related to the **safety and health** of individuals, and are ubiquitous worldwide.

- Shoes have a long and complex list of performance **requirements**, that vary considerably depending on the intended use.
Why study shoes?

- The long history of footwear illustrates the evolution of production processes and the organization of labor, as well as environmental impacts.

- Today this industry has large economic and environmental impact, highly centralized manufacturing and a complex supply chain, due to the outsourcing of production.

  ✓ Product developers
  ✓ Product developers and manufacturers
  ✓ Manufacturers
Environmental Issues in the Footwear Industry

Materials
- Use of hazardous materials and chemicals in shoe manufacturing, particularly the use of chromium – a highly toxic element – in addition to toxic solvents and adhesives and non-recyclable synthetic materials can pose serious risks to human health and the environment.

End-of-life
- The global production of footwear is 20 billion pairs/year, leading to an average of ~3 pairs/person/year (8 in U.S.).
- There are issues related to all EoL options: reuse (cultural), remanufacturing (disassembly), recycling (materials variety), energy recovery (emissions), and disposal (landfill space and infrastructure).
Environmental Issues in the Footwear Industry

Water

- Large amount of water used to produce the materials, as fabrics, leather and synthetic petrochemicals.
- 53% of global cotton fields are irrigated, producing 73% of the global production, including organic cotton.

Energy

- The source of energy is usually related to each country’s energy mix. (In China, for example, 80% of electricity comes from coal.) Due to outsourcing of production, companies have limited control over energy sources.
Environmental and Social Issues in the Footwear Industry

- Outsourcing of production transfers some of the main environmental concerns to other countries.

- **Environmental problems** related to manufacturing, consumption and end-of-life disposal commonly **take place in different nations**, subject to varying levels of monitoring and control.

- Besides this, there are many issues related to labor practices.
Goal: to summarize the main initiatives currently being developed by the companies and analyze them from a perspective based on the cradle to cradle concept.

- **American Case**
  - The largest global market for footwear products: around 2.4 billion pairs = 8 pairs/person/year
  - Focus on **product development** and outsourced production; footwear imports account for 99% of consumption

- **Brazilian Case**
  - It is characterized by both product development and manufacturing (804 million pairs a year)
The American Cases: Companies’ profiles

**Nike**

Mission: “To bring inspiration and innovation to every athlete* in the world.”

- Formulated a Considered index of material analysis

**Patagonia**

Mission: “Build the best product, cause no unnecessary harm, use business to inspire and implement solutions to the environmental crisis.”

- Has the map of supply chain for products: Footprint Chronicles

**Simple Shoes**

Mission: “The important thing is we're committed to making our product 100% sustainable.”

- Launched Bio-D line in 2010, with bio-degradable soles
The main challenge for companies like Nike is to seamlessly integrate sustainability into its product line (and image) without decreasing performance.

The list of constraints and requirements is quite different in the case of a company like Simple Shoes, whose primary business is to produce, market and sell casual shoes that are as environmentally-friendly as possible.

Despite such differences, the sustainable product development initiatives carried out by both companies have important similarities.
The American Cases – some highlights

A few characteristics common to all initiatives:

- The use of water-based adhesives, primers and solvents reduces considerably the toxicity of the product assembling process.

- Investigation and increased use of green and natural rubbers.

- Aiming to limit environmental impact due to the high toxicity of chromium, companies have collaborated with the BLC Leather Working Group and adopted rigid production, treatment and control practices.

- Use of natural fibers (organic cotton, flax, hemp silk, cork, wool and cashmere) and recycled materials (polyester).
The American Cases – highlights

- Reverse logistics strategy (Reuse-a-shoe)
- Good examples of Design for Disassembly

Sugar and Spice by Patagonia
The Brazilian Case

- Most Brazilian companies have their own brands and develop and manufacture their footwear products, although several companies also have contracts with foreign companies to manufacture shoes with international brands.

- The Brazilian footwear industry is in a situation similar to that encountered by the American industry in the 1970’s, in the beginning of outsourcing.

- No significant investments have been directed at empowering product development teams and fostering innovation, particularly with regards to environmental issues.
The Brazilian Case

A green product line was launched in 2008, with the main goal of incorporating as much recycled and environmentally-preferred materials as possible:

- Organic cotton dyed with natural pigments;
- A natural fiber called jute;
- A vegetable “leather” made out of natural latex extracted from a Rubber Trees by local forest communities;
- Use of recycled PET in a fabric that combined 50% virgin polyester and 50% PET fibers recovered from plastic bottles.
Most initiatives do involve the main areas highlighted in the cradle to cradle approach: materials use and reutilization, water use, energy consumption and social responsibility.

It is not possible to evaluate environmental sustainability without taking into consideration the size, structure and core business of the companies.

The level of constraints that product developers deal with during product design and materials selection can vary considerably depending on the intended use and performance required for a given product, including strength and durability.
Final comments

- Product **end-of-life issues** are crucial barriers to be overcome in the evolution towards a closed-loop and cyclic production.

- The **consumer role**: returning apparel items after use for recycling is not a common practice

- While notable initiatives have been developed in recent years, especially by American companies, with significant efforts conducted on all key areas of impact, there is still a **long way to go** before footwear products can be considered truly sustainable

jocelise.jacques@ufrgs.br    agogino@berkeley.edu
Future work

- Compare specific green products (representing current best practices) to their conventional counterparts, in order to gauge present improvements and evaluate how close (or far) they are from the cradle to cradle benchmark.
Sustainable Product Development Initiatives in the Footwear Industry based on the Cradle to Cradle Concept

Jocelise J. Jacques - jocelise.jacques@ufrgs.br
Alice M. Agogino - agogino@berkeley.edu
Lia B. M. Guimarães - lia@producao.ufrgs.br
Back Up Slides

Back Up Safely
Nike Considered

http://www.huntergatherer.net/
By 2020 Nike Claims They Will:

• Eliminate waste in product design, using materials, energy, resources that can be recycled, renewed, reabsorbed back into nature.

• Eliminate all substances that are known/ suspected to be harmful to human health or the health of natural systems. (eliminate PVC)

• Close the loop for all stages of product and process lifecycle, including the end of a product's useful life.

• Develop financial structures that promote greater product stewardship in design, engineering, and manufacturing.
- Leather (a renewable resource) pieces are stitched in an overlapping fashion so as to produce smooth internal seams, obviating the need for comfort liners and reducing the shoes's material mass.
- Use of hemp and organic cotton.
- All of those leather pieces are tanned using a vegetable-based process.
- To save material mass, metal eyelets aren't used.
- Where possible, materials are sourced locally to reduce transportation energy use (within 200 miles).
- The two-piece outsole is designed to snap together, eliminating harmful adhesives and simplifying recyclability.
- No use of PVC.
Nike Considered: Where innovation meets conservation

- 60% less waste
- 37% less energy
- Reducing solvent use by 80%
- Uses recycled factory rubber

Hemp used for woven upper and shoelaces
nikeconsidered TODAY

- Screened tech call out (by screening, we eliminate rubber inserts and therefore waste)
- EPM regeneration strobel. (Nike encourages the use of EPMs—environmentally preferred materials—that include regenerated or recycled, fewer toxins, or organic materials.)
- Drop-in midsole that snaps together with outsole to eliminate adhesive between these 2 parts. (Nike’s industry-leading efforts to reduce petroleum-based adhesives in footwear have reduced the use of chemical organic solvents by approximately 95%)
- Injected Phylon Midsole for minimal waste
- Midsole drainage holes for performance and snap-fit construction (to reduce the need for adhesives and enable future disassembly for Nike’s recycling efforts)
- Environmentally preferred rubber heel counter with recycled content. (EPMs such as the one that comprises this heel counter represent Nike’s effort to reduce and reuse waste by creating closed-loop systems and other recycling programs that currently divert 60% of footwear manufacturing waste from landfill)
- EPM laces (100% Recycled content)
- Environmentally Preferred rubber toe tip using recycled content – 3D mold reduces waste
- Entire shoe is PVC Free. (We’ve removed materials containing PVC from our approved material list for Nike branded product)
- 0.44 sticky rubber outsole and environmentally preferred rubber (EPR) sidewall with recycled content. (Our EPR reduces toxins 96% by weight from our previous compound. In our last fiscal year, 54% of Nike brand footwear used this type of rubber)
ACG - All Conditions Gear
It’s like a shoe pretending to be a bag you can carry your groceries home in....
Tree Hugger Discussion

- I will continue to boycott Nike, token environmental shoe or not, until they clean up their human rights record in Asia.
- If it uses so much less, why it cost so much?
- I'm sure that Nike based the price on a logical assumption: They will only sell 1 pair of these shoes for every 20-50 of one of their normal shoe lines, so they can't reach nearly the same economy of scale. I'm even willing to bet they're making little or no profit on this line, but are treating the Considered line as a marketing or public relations expense. That's just how it is in high-volume manufacturing.
- In the end, we'll have to see whether this latest attempt by Nike is for real. But it's sure good to see them trying.
Supply Chain: From 100% Organic Cotton to Organic Milt

- Rogan Gregory and Scott Hahn of Rogan and Loomstate “right off the loom” develop successful sustainable business models: “managing the supply chain”. The supply is of Organic cotton. The chain? Sustainable farming.

- Along with 100 pounds of fiber comes about 162 pounds of cottonseed - the amount that one cow eats per month.
Key Lessons

• Appreciate what consumers want: Sustainability, but not at the expense of performance and aesthetics.

• Materials and energy trade-offs are dynamic over time and vary with local conditions.

• Organic Exchange: Oct. 31-Nov. 2 Monterey (Eileen Fisher, Cap, Levi, Loomstate, Nike, Patagonia, REI, Timberland, etc.)

• Consider the supply chain and the message.
  • http://www.ecotextile.com/
  • http://www.organicexchange.org/

• There is no finish line.