Waste as Parts: Reassessing waste value for a sustainable future

Patricio Corvalan

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Waste as Parts
Reassessing waste value for a sustainable future
by Patricio Corvalan

A Thesis in Partial Fulfillment of the requirements for the
Degree of Master of Fine Arts in Industrial Design

School of Design
College of Imaging Arts and Science
Rochester Institute of Technology
Rochester, NY
May 10, 2015
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Thesis Abstract:

In a context in which solid waste is a major issue within current society problems, “Adopt a Product” is a line of home objects that uses the structural qualities of disposed plastic containers in their design. Exploring an underestimated material resource brought the idea of using overly reinforced food packaging to make affordable products. With the implementation of this fabrication approach, the input of used packaging into landfills and new plastic into the market are reduced. Using existing strong containers taken out of industrial and commercial kitchens allows small and new born companies to manufacture their own products by avoiding expensive technologies with a high initial cost, like plastic injection molding. This line of products is simple, functional and their pieces are easy to replace. From packaging to replace worn out pieces, the underlying idea is to make things easy to their users. Adopt a Product’s intention is to create compelling designs that will help modifying the mental model of material quality; achieving a different and more sustainable consumers’ mind set.
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Introduction:

Sustainability has emerged as a result of significant concerns about the unintended social, environmental, and economic consequences of rapid population growth, economic growth and consumption of our natural resources. (U.S Environmental Protection Agency, 2012)

Despite theory, tools and practices for controlling and preventing pollution, there is a huge part that is not being addressed; usually due to the lack of economic benefit on it. Part of the objectives of this project is to explore the economic benefits of these unattended areas, and to make them tangibles.

The idea is not only address the moment in which waste is separated in recyclable and not recyclable, but to address the following parts of the waste management system. In more general terms, sustainability is the endurance of systems and processes. Therefore, how can we connect the waste management process to the manufacture process?

Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations. (Sustainability, U.S. Environmental Protection Agency, http://www.epa.gov/sustainability/basicinfo.htm)

“In the 1990s, concepts such as ecodesign and green product design were introduced as strategies companies could employ to reduce the environmental impacts associated with their production processes. One ecodesign methodology, Design for Sustainability (D4S), has evolved from general Cleaner Production methods to focus on products and to include social, economic, and environmental elements of production.” (Clark, Kosoris, Hong and Crul, 2009)

One of my goals with this Thesis is to attract others to sustainability. To show to people what can be done with the things they are throwing out while reducing costs with an alternative manufacturing process. All this within the frame of Sustainability for Design, that includes a stronger approach on the social aspect.
Plastic

Something new. The resin which can be molded by heat and pressure to any shape.
At the dawn of the 20th century, science invented synthetic plastics, and the world would never be the same. [...] 
Today, everywhere we go, we are surrounded by plastic.
We drink from it, eat from it, wear it and use it in almost every part of our daily lives.
This miraculous invention and its evolution have created a new era of cheap, convenient and disposable products that have transformed the way we live. And it’s hard to imagine what we would do without them.
Plastic is too firmly embedded in modern life. But plastic is unlike any other substance on earth, for one very specific reason.
It never goes away.
Because plastic is such a perfect creation, it’s virtually indestructible, which means that almost every molecule of plastic ever created is still somewhere on this planet.” (Plastic Paradise, film, 2013)
**Statement**

Food transportation always needs some sort of container. Part of these containers can be reused once cleaned, but the other part, the bigger part, has been designed for a single use. These are disposable. Hence, food packaging represents an important quantity of the waste that goes to the landfill. This Thesis intention is to conduct a study about the characteristics of this type of packaging in order to identify the ones that can be utilized for the fabrication of consumer goods.

Plastic containers, when not sent to the landfill, usually follow two possible paths. The first one, when regular people reuse them in a sort of handcrafted way, in which they grab used packaging and try to transform it in such a way to give it a second use. Most of the times to cover a specific need, like storage or lighting. The second use these objects experiment is a more elaborated process of recycling, one that occurs at an industrial level. This recycling process requires a great amount of energy and efforts to be carried out. This process requires gather plastic containers made out of the same material, to shred them into flakes and use these as a raw material. The same way pellets are used, these new flakes are melted into plastic sheets that later will be CNC cut similar to plywood. Hence, from used plastic containers to new plastic pieces there is a lot of heat, electricity and plastic chips coming out of the milling process.

This thesis main intention is to elaborate a middle ground between the two approaches in which plastic containers are recycled or reused. Also to create jobs at the same time than reducing the amount of electricity and machinery required in the fabrication of consumer goods made out in the most part by this valuable and underestimated material resource.

Some types of ingredients’ containers offer a great structural quality in order to hold a second life. Through using this rescued polymer material, an alternative resource can be offered to small and newborn companies in order to create their own affordable line of products and, at the same time, reducing initial capital to set up a small productive layout. From the social point of view, the emergence of small businesses of this type will create jobs at a local level.
The main intention in this Thesis is to propose a different kind of manufacture system, one in which the input of elements that are considered as waste in certain environments will help to reduce initial cost, processes and also to deviate material out of its way to the landfill. This kind of configuration will work with limited, but not small, batches of products; taking into account that consumer goods are in constant change.

There are several stages in the cycle that takes from the development of a particular object as a starting concept to the moment in which this product is put on the shelves as one more option for consumers. Some of the most common mass produced objects, such as lamps, chairs, phones and many others require a big amount of initial capital to start manufacturing them. On the other hand, a great deal of products are made with standard pieces, as an example, a collection of office chairs that use the same 5 star base. This project will try to propose a manufacture system in which a percentage of elements, specially selected from particular waste streams, will serve as a starting point from which a design team will think in a set of products that can be made out from such recovered elements.

An empty ice-cream plastic container is as translucent and structural as a typical lamp shade, a small plastic barrel that used to have cooking ingredients inside sounds better than a toy drum set for kids, some high density cardboard boxes are great for working a speaker box. Some of these situations came from home-made projects in which common people came to realize about the inherent characteristics of these pieces of ‘waste’.

Opportunities and benefits

This research and exploration of ideas have as an ultimate goal to change people’s mind about what a product should look like and the set of qualities they should expect from them. All this framed within current concerns about the limitation of resources. On top of that this project, seeks to inquire into the benefits, cost, time, environmental impact and other factors from both the current manufacture system and the one mentioned above, to check if the second one would worth it. It is assumed that not every piece of waste can be used in producing other objects.

Going back to the manufacture stage, by using already existent pieces instead of manufacturing them from scratch, a company can avoid going into important costs such as plastic injection molds, injection machines, metal bending machines, etc.; allowing reducing the retail price and in this way, to compete in the market against more expensive products of the same category.
Research

Fall 2014 / spring 2015

Different discarded food service and ingredients’ packaging were analyzed in order to detect the ones with potential for a second life. On top of that, also the places in which these pieces of packaging are used were researched in order to understand how these systems work; where do they put the discarded containers, how many different types of ingredients’ containers can be found in one store, the numbers they manage weekly and if they are willing to separate useful packaging from the one they normally throw to the trash.

There are certain strong plastic containers which are used in several industrial kitchens. These also maintain a standard shape, something that will benefit their use as raw material for building other products.

Different sources about sustainable design, new manufacture models, waste treatment and social practices were consulted in order to create a reference framework to develop any alternative system or products.

In order to check if the proposed fabrication model can be applied in other latitudes, the same questions were asked to food store managers in a trip to Argentina during January, 2015.

Research Plan

- Identify the types and shapes of plastic that can be upcycled
- Explore ideas using the characteristics of these plastic pieces
- Identify consumer goods areas where this concept can be applied
- Go over integration of scales / mass produced + locally made parts
- Simple and affordable ways of manufacture
- Emotional attachment to products

Project Objectives

- Reduce the amount of plastic going to the landfill
- Reduce the input of new plastic into the market
- Generate resources for small/medium and newborn companies
- Create jobs at a local scale
- Encourage others to participate in sustainability
America on Recycling:

In 2012, Americans generated about 251 million tons of trash and recycled and composted almost 87 million tons of this material, equivalent to a 34.5 percent recycling rate.

Our trash, or municipal solid waste (MSW), is comprised of various items Americans commonly throw away after being used. These include items such as packaging, food waste, grass clippings, sofas, computers, tires, and refrigerators. MSW does not include industrial, hazardous, or construction waste. In 2012, Americans recovered over 65 million tons of MSW through recycling and over 21 million tons through composting. We combusted about 29 million tons for energy recovery (about 12 percent).

About 135 million tons of MSW (53.8 percent) were discarded in landfills in 2012 (says EPA on its 2012 report about Municipal Solid Waste).

Sources of MSW

Sources of MSW include residential waste (including waste from apartment houses) and waste from commercial and institutional locations, such as businesses, schools, and hospitals.

Plastics comprise about 13 percent of MSW.

Foodservice and Ingredients’ packaging treatment

Problems

Food packaging and containers used to ship the ingredients with which food is prepared tend to last an excessive amount of time more than the content they protect. Once these containers are empty they are not considered containers anymore. They are now called trash. And trash is sent to the landfill.

Why foodservice packaging is not being recycled?

“According to the U.S. Environmental Protection Agency, paper and plastic foodservice packaging discarded in the country’s municipal solid waste stream accounted 1.3 percent in 2007 (by weight) of municipal solid waste.¹ The U.S. Environmental Protection Agency also says that an often-cited waste prevention measure is the use of washable plates, cups, napkins … instead of the disposables variety. (This will reduce solid waste but will have other environmental effects, such as increased water and energy use.)

Most foodservice packaging can be recycled, but isn’t for a variety of reasons. According to the Foodservice Packaging Institute, the biggest barriers to recycling foodservice packaging items are public health and economics. Once used, foodservice packaging is considered contaminated, and thus much of it is unfit for recycling, unless it is cleaned and sorted. Some places have successfully found ways to recycle
such packaging including, but they've met with limited success.” (Municipal Solid Waste, EPA official website, http://www.epa.gov/epawaste/nonhaz/municipal/index.htm)

**About Resource Conservation**

Recycling and composting prevented 86.6 million tons of material away from being disposed in 2012, up from 15 million tons in 1980. This prevented the release of approximately 168 million metric tons of carbon dioxide equivalent into the air in 2012—equivalent to taking over 33 million cars off the road for a year. Learn more about how common wastes and materials, including food and yard wastes, paper, metals, and electronics, contribute to MSW generation and how they can be recycled.

Recycling and composting recovered waste require processes that use energy and other resources to treat such material. This is one of the reasons why this project aims to use such containers the way they are, taking advantage their natural structure, strength and other properties.

**Numbers:**

In order to picture a rough idea about the waste problem concerning food packaging, these are some numbers regarding the subject matter: Together, food and packaging/containers account for almost 45% of the materials landfilled in the United States, and some of these discarded materials are food-related packaging and containers. 377,579 tons of polystyrene are produced in California alone, including 154,808 tons of food service packaging. That is 154,808 tons of over-processed plastics designed to head straight to the landfill after a use time of a minute or less.
Local Case Study 1: Gracie’s.

An observational visit to Gracie’s, the biggest dining location at Rochester Institute of Technology was made to collect rough numbers about the amount of waste they manage every week. After observing the different types of plastic, metal and cardboard containers; the ones with enough structural resistance for a second life and with an acceptable finish were selected. Furthermore, Scott Vadney, Gracie’s general manager mentioned the amount of that kind of containers that are thrown weekly.

Where can we get a flow of incoming resources?

How stable in time these resources can be?

How can these resources be shipped to each design/build production cell?

**Container 1:** Used for yogurt, sour cream, jelly and other kind of food produce.
100 weekly – approximately 400 a month

**Container 2:** Used for transporting Boiled Eggs container
6 weekly – approximately 24 a week

**Container 3:** Used for Kosher pickles and other food produce.
21 weekly – approximately 84 a month

**Container 4:** Used for condiments and small cooking ingredients.
14 weekly – approximately 56 a month
Besides containers’ numbers, Scott mentioned that their provider has a 2 years contract. This means that depending on the date, this dining hall can be considered as a stable material resource for a given amount of months, up to 2 years. Also, their type of contract can be found in places other than Universities: Hospitals, Schools or big restaurants and fast food stores. Therefore, the potential number of containers that can be collected in a specific urban area will depend on the size and the amount of this kind of places.

**Local Case Study 2: The Wok**

A visit to an Asian restaurant that is attached to the University of Rochester was made to inquire about their waste. Two similar kind of big produce containers were found and the kitchen manager mentioned that they throw 20 of each monthly (40 strong containers). This is a much smaller restaurant if it is compared to Gracie’s. Also, this is an on street/open to the public restaurant. It is not targeted specifically to students.

**Conclusions**

This research intends to dig into different kind of places with a considerable outgoing waste stream to be considered as a material resource. Planning ahead a strategic schedule, the company which is going to be using these elements taken out of the waste stream can have enough control to search for new resources before a possible turn in one of the key points.
A specific collecting and shipping system should be developed for this project to work on a stable manner.
**Why working with ingredients’ plastic containers?**

. Plastic has an incredible long life span.
. The amount of plastic containers discarded by food industry.*
. Some these plastic containers have a great structural resistance.
. They can be collected at a specific location before they reach to transfer stations, or worse, landfills.
. They provide a constant flow of material.

*Reasons to reduce Wasted Packaging*
Containers and packaging alone contribute over 23% of the material reaching landfills in the U.S., and some of these discarded materials are food-related containers and packaging. Additionally, packaging makes up a majority of the litter that ends up on our beaches and other waterways. This is a problem because fish, birds, and other aquatic wildlife are often harmed by ingesting plastic bags and other debris from packaging. Waste in the ocean also causes navigation hazards for boats and results in losses to the shipping, fishing, and tourism industries. (EPA, Reducing Wasted Food & Packaging Toolkit)

**Hypothesis:**
By creating functional and appealing objects using selected waste elements as substantial parts, while considering such parts in the beginning of the design process will:

. Reduce the energy and processes required in manufacturing new pieces.
. Reduce the initial cost of production.
. Divert such waste from its way to the landfill.
. Create jobs (manufacture, assembly, logistics, shipping of products).
. Hill help moving people’s perception one step closer to a new quality of products more suited for a sustainable future.
**Fast food chains**

**Thinking globally**

Nowadays there are 14,267 McDonald’s stores in the US. All of them use some type of plastic containers. With different thicknesses and different opacities, all of them have their own freestanding structure. Only in Rochester, that is a small/medium size city 64 fast food stores can be found, only counting the mainstream brands (McDonalds, Tim Hortons, Burger King, Wendys, etc.).

A shelf-stable, high-density polyethylene container of sliced pickles.  
(0.8-gal) HDPE FS-100

The tub measures 7” x 63/8” x 8” deep  
6 a day, 42 a week, 180 a month.  
x 24 Stores in Rochester= 1,008 containers a week.  
4,320 a month  
This means that if we need a supplier of these used containers in a specific city, we can rely on an input of around 1,000 containers a week.

Can this business model be replicated in other countries?  

The same set of questions were asked to dinning places, fast food stores and American fast food stores franchises’ managers in Argentina.  
- What type of containers you are using in this store?  
- How mane of such containers you receive daily or weekly?  
- What happen with them after used?
Mc Donalds > Tucuman, Argentina.

“The pickles come in clear plastic bags inside cardboard boxes. Pickles, cucumbers and other ingredients come in the same way. On the other hand, hamburger buns come in biodegradable plastic bags. French fries also come in these bags.”

“We receive all the stuff at 6:30 am. After using the ingredients we split the plastic bags on one side and the cardboard boxes on the other. Plastic bags are thrown to the trash. Cardboards are picked up by recyclers.”

Il Postino > Italian Restaurant. Tucuman, Argentina.

This restaurant does not produce packaging waste on fresh produce. For the rest of the ingredients they use plastic bags, paper bags and a few cardboard boxes.

The provider has their plastic crates and the restaurant has their plastic crates. Hence, produce are moved from one to the other when providers visit the restaurant. Although that in this case the restaurant doesn’t throw plastic containers, the reusable containers model is interesting as an alternative to the previous cases. This one is a system that produces less waste.
**Philosophical Aspects**

**Why waste is considered waste?**

“Objects gain and lose something when they are abandoned as rubbish. What they lose is related to their presentation by advertising as desirable commodities: newness, utility, wholeness, a distinction from other objects, or at least a resistance to arbitrary merging. The presentation of the commodity in advertising photography has been, almost from its origin, to stress these qualities, to mark the object as highly distinct from its surroundings – however appropriate they might be – to stress its cleanliness, to light it in order to emphasize the clarity of its borders.” (Stallabrass, 2009)

In this analysis, Julian Stallabrass is talking about what seems to be consumer goods. Some similarities can be found between those and ingredients’ containers on arbitrary merging once both of them are discarded. What packaging loose when disposed is not its shiny surface or the clarity of its borders; what it really loses is its content. Once they are empty, they go unregarded, *edited out of vision*, as the author says.

On the other hand, ingredients’ packaging is a totally opposite concept from “a distinction from other objects”, they all look alike whether being shiny white or translucent; they are all capsules with a content. It seems to be that without content, without a purpose, packaging becomes in *immediate trash*.

The question is “**Can one makes them desirable again?**”

My idea is that by giving them a purpose, a kind of symbolic content, they can return to the environment of attractive and useful products. They may have a different value.
**Theoretical Research**

The following is a collection of what design theorists think regarding consumer goods and their role on the construction of social practices. They all talk about a change in our mind frame in order to fully embrace sustainability in design. Also I analyzed these excerpts in relation to my Thesis.

**The Future of Material Culture**

**Industrial sustainability /**  
**By Peter Danko**  
We are about to witness the birth of a design style embracing the marriage of sustainability with industrial production. [...] So how do we alter the mental model of our culture to build a sustainable world society?  
(Brower, Mallory and Ohlman, 2005)

**Innovation of local systems /**  
**by Ezio Manzini**  
We need to create new forms of community. [...] It is not possible to take significant steps toward sustainability using existing ideas and methods. [...] These unconventional ways could be the seeds from which new ideas for lifestyles, production, and economies can grow. (Brower, Mallory and Ohlman, 2005)

**Conserving Effort/**  
**By Ed Van Hinte**  
“Going to mars doesn’t get you anywhere. However it takes a huge effort, in terms of time, money, and danger. [...] This does not imply that design would have to disappear altogether. Presupposing that the system to provide the world population with water, food, and shelter would be in a state of perfection (which is not likely to ever happen) the difference will be that design would no longer be concerned with new objects.  
(Brower, Mallory and Ohlman, 2005)

**Our Products and Our Values /**  
**By Peter Danko**  
“The products we choose reflect who we are -our values, our heritage, and where we fit in the social hierarchy-. The issue of sustainability has recently become a consideration when we choose products. Sustainability, however, will never be the sole key to the success of a product. As always this will be its design and how it reflects our values. So, in order to become a sustainable society, our values need to evolve so that we perceive products from a different frame of reference.”  
(Brower, Mallory and Ohlman, 2005)
Conclusions:
Most theorists within the design field support the idea of a transformation in our current society to one with more sustainable values. While Manzini says that we must change our values for that to happen, Danko claims that it is bound to happen. Some differences can be found within this set of perspectives; however, some aspects seem to be quite clear. An evolution of values, conserving efforts and to take advantage on the benefits of communities, are some necessary paths that take in order to achieve this sustainable future.

About Alternative Manufacturing Systems

In order to propose an alternative fabrication method, I first researched on existing alternative systems and one with the same goals was found, but developed in a deeper lever, probably to be applied at a bigger industrial level. The system that matches the direction of my thesis is described as the following:

Closed Loop Manufacturing System focusing on Reuse of Components
Environmentally conscious manufacturing has gained more and more interests in recent years. For achieving it, closed-loop manufacturing system where products are made from used products, parts and materials taken-back from market, as well as new ones, should be established. Focusing on factories, complicated fluctuations of amount, quality, and timing of these taken-back resources make effective planning and control of these factories very difficult. In this paper, a conceptual factory model of a closed-loop manufacturing system is designed considering material flow, with these various kinds of fluctuations. It also illustrates a prototype factory model that has developed for aiming at handling these fluctuations. (Umeda, 2005)

Integration of Scales
In his book “Sustainable by Design”, Stuart Walker claims that design centered on local production has many environmental and social benefits; some of them as social equity and economic development. Sustainable product design, he says, must combine and integrate scales -using locally and regionally produce parts from regional materials in combination with mass-produced parts (Walker, 2006). His reasons to back such reassessment of production scales lay under the fact that with that approach products would be able to be made, repaired and reused within an industrial ecology of cyclic resource use at a local or regional level. Although, on the other hand, there will still be many components that would be more appropriately manufactured in high quantities, due to safety and compatibility reasons.
Target User

One of my first thoughts regarding this project was to offer alternative and more affordable solutions to classic needs within the area of consumer goods; a lamp, a desk, a stool, a tray, and so on. This decision was taken under the idea that people will not take the risk of buying more expensive categories of products; a laptop, a cellphone, a camera, coming from an unknown brand that is reusing recovered materials.

After researching in blogs on sustainability, DIY projects, and environmental reference web pages I had decided that my target user needed to be all the people concerned about these subjects, people willing to acquire eco-friendly products but having problem finding them.

But after having feedback from my Thesis advisors and put into more thought, I realized that the product should be marketed to young people that will be more open toward trying a different quality of artifacts. If affordable and appealing, this line of product can achieve success into the market of college students. An affordable and alternative solution, distinct from conventional dorm equipment, might be well received by this audience.

Picture source: My College Guide
**Benchmarking:**
The analysis of the following cases was organized in two parts. The first one concerned to cases and products that were chosen as references for the entire project, and the second part is split in categories; each one based on a specific type of product that has interesting aspects to take into account during the concept development.

**Benchmarking – part 1:**

![PrefabDesign furniture](image)

**Assembly**
*PrefabDesign furniture*
*Designed by Dave Keune, Netherlands*

"Dave Keune likes to think that the do-it-yourself quality of his PrefabDesign makes it people-friendly. This children's furniture set was designed for self-assembly by a parent and child, creating a meaningful and engaging, yet easy experience. His PrefabDesign encourages the buyer to be involved with the construction of the product which, for Kenue, is in contradiction with current culture. By putting together the final object, the owner is more likely to develop an emotional bond with the product and to keep it for a long time. PrefabDesign also packs flat for ease of transport and minimal use of materials." (Brower, Mallory and Ohlman, 2005)
The Product being its own Packaging

Product: Box Up Chair
Designed by Peter Hancheck

This chair is one of the references regarding the use of materials, the way in which is assembled and its environmental impact. Its qualities claim being transportable, having low-impact materials (felt and plywood, both biodegradable), and easy to assemble.

"[...] ...a soft, warm, friendly seat designed specifically for ease of transportation and assembly. With Box Up, the seat itself is the carrying case for its structural components. The pieces are put back together using snap fasteners." (Brower, Mallory and Ohlman, 2005)

One of the interesting aspects of this design is the way Hancheck use the structural part of the chair as a carrying container. For small objects this idea can be applied in a way in which the main structural part can work as part if not the entire packaging.
**Case 1 – Reinterpretation of milk crates**

*Crates – Modular Storage System*  -  price $29.99  
*Made by Quirky / NYC*  
*Designed by Jenny Drinkard*

“*Crates* is a contemporary spin on the classic milk crate. Part of a modular storage system, its accessories can be mixed and matched to create a custom setup. Use it to decorate a college dorm, tuck away toys, or organize your laundry area.” (Product description, [https://www.quirky.com/shop/315](https://www.quirky.com/shop/315))  

The combination of wooden and plastic pieces plus, its proportions, give an attractive look to this storage system. It is pretty normal for college students to use plastic crates to organize their stuff in their dorms, but this design took the idea to a more stylish and functional version. Plus, Quirky has been able to increase the value of a $5 plastic crate from Target to a $30, more durable, alternative.  

The downside: From the sustainable point of view, Quirky is not reusing old milk crates. They actually made an injection plastic mold to create new crates that fulfill Drinkard’s design needs.
After researching on a variety of simple lamps I developed a briefing on what aspects will benefit the relationship with the user on one side and fabrication on the other. Also, they have to match with the entire line of products.

- The design should resemble the iconic shape of a lamp
- Simple assembly
- Three support points for stability
- A reduction of elements, just the shade and a structure
- Minimum amount of manufactured pieces.

**Benchmarking Takeaways**
Case 1 - Thoughtful Materials

Suck UK

Cardboard Radio + Portable Speaker - Price $19.99

Designed by Chris McNicholl

This radio is made by the minimum electronic components required to give it the functions of a basic radio wrapped around by a cardboard shape. Hence, the whole exterior case is recyclable.

Even no glue has been used to assembled it. "The basic principle behind the design of this radio is to simplify user interactions. This is possible because the product is supposed to be assembled by the user himself." “Suck UK Product Description,” http://www.suck.uk.com/products/cardradio/

Its website claims that this product works with 4 AA batteries generating good volume level without distortion. Although the book “Sustainable by Design” states that the use of batteries in products is not environmentally friendly due to batteries having limited lifespan.

Having the minimum structure possible and the minimum electronic components is a principle to be applied in the concept development of this project’s sound unit.

Price point: The official website sells the radio for $40.00 UsD, although Amazon sells the same product for $19.95 UsD.
Case 2 – Affordable quality alternative

BTV2 Portable Bluetooth Speaker
AmazonBasics
Designer: Unknown

AmazonBasics is the company's generic in-house brand that bypasses the middleman and pushes cost savings to the customer. In this case, the BTV2 only costs $29.99. This portable speaker is a popular and affordable alternative for people looking for small speakers. I chose this specific model because of its price and the quality it offers. Amazon as a company has in their hands an extremely powerful advantage when it comes to research. Almost all the brands have to go through Amazon sales to increase their market. Hence, Amazon has access to analyze all the products of one category and develop their own to compete in the market. That is what they are doing with many types of products, including speakers. Amazon offers this speaker for $29.99 and it has the following characteristics:

- Contains one internal 3W speaker and built-in microphone for hands-free calls
- Bluetooth connection
- Up to 10 hours of wireless play on a single charge
- USB charging
- Dimensions: 3.3 x 1.7 x 2.6 inches (LxWxH)


The idea is to take this price as a reference for affordability in small speakers.
Case 1 - Magazine Stool
Magazines, belts and a pillow.
Designer: unknown
During the benchmarking process I found this stool that is repeated in numerous green blogs and reused objects articles. These kinds of cases are usually presented to curious blog readers, people looking for DIY projects or just people looking for cheap solutions that can be easily made at home. Most of them are almost self-explanatory due to their visual simplicity. If no instructions available, one can try to just make one by looking at the picture.

Case 2 – Skateboard Furniture
Recycled Skateboard Stool
Company: Deckstool, USA.
“Solidly crafted using real broken skateboards harvested from skateshops and skateparks across the U.S.A, every piece of deckstool furniture is one-of-a-kind. We use modern manufacturing techniques to create precision parts and skilled skater/craftsman to finish and assemble them with an artist’s touch.”
(Front page of Deckstool official webpage, http://www.deckstool.com/products.htm)
Broken skateboards are both the inspiration and the raw material for the Deckstool. In the description of the raw material they mention “Incredibly strong”. Something I found that the containers of my thesis and the worn out skateboards have in common. The people who build this furniture discovered a used material with great characteristics; therefore they decided to make something of good quality that they can sell.

Benchmarking Conclusions

Self-assembly
Self-assembly creates a meaningful and engaging experience, although it needs to be an easy process to avoid frustration, developing an emotional bond with the product.
I understand that the emotional bond will depend on factors like the moment in which is assembled, the context, the materials of the product and how easy is to do it. All in all, is an interesting strategy to create an emotional attachment that will encourage people to take better care of their product.

Minimum Packaging
The idea of having one piece that is also the carrying case is really interesting and will trigger solutions that would imply the reduction of the packaging. Nevertheless, it will still need a minimum packaging for branding and information purposes. On top of that, when disassembling the product for transportation, the user would be able to store it inside the product itself.

Modular Storage System
When analyzing the Quirky project called Crates, I noticed that is a great idea but applied in a non-sustainable way. There is no reusing at all. They are even creating more plastic crates. On the other hand, the idea of creating a modular storage system by linking the containers is the aspect I find worth to develop, but, with a more sustainable path.

Electronic components and case relationship
By observing the instructions on the Suck UK cardboard radio it can be noticed that the placing of electronic components inside a biodegradable or recyclable case must be achieved in a few simple steps. The ideal situation is that neither screws nor glue should be required to assemble electronic onto the main structure of the artifact.
**Visual appearance**

After researching a variety of reused and recycled objects and commercial products my conclusion is that the recovered element should not be disguised or hidden. The reason behind this statement is that one of the fundamental pillars of this thesis is to educate and train the eye of consumers in order to make them more receptive to the new quality of objects proposed here.
Concept Development

One of my first thoughts regarding this project was to offer alternative and more affordable solutions to classic needs within the area of consumer goods; a lamp, a desk, a stool, a tray, and so on. This decision was taken under the idea that people will not take the risk of buying more expensive categories of products; a laptop, a cellphone, a camera, coming from an unknown brand that is reusing recovered materials. Although there are cases of companies using recycled materials, like House of Marley (official website: http://www.thehouseofmarley.com), they have a different approach. “Marley uses earth-friendly materials such as recyclable aluminum in an effort to keep materials out of the waste stream.” (as the company states on its website, http://www.thehouseofmarley.com/headphones/positive-vibration-on-ear-headphones.html). In this case, they use materials that can be recycled at the end of the product’s life and also the use recycled cotton, canvas and plastics in the fabrication of their products. This company is backed by the last name of the famous reggae singer, Bob Marley, which provide some sort of trust in consumers of audio equipment. Hence, this is not the approach to take with a small size company that needs to start with its line of products.

Finally, I decided to focus on general areas: lighting, sound, seating and storage. The reason why I spread my design concept in four areas is to better communicate how broad can be the application of this idea.

Raw Material

**Big container:** Used for shipping pickles, kosher ingredients, cucumbers, boiled eggs, and other ingredients.

**Small container:** Used for ice cream, frozen yogurt, sour cream, cream cheese, frozen berries and other ingredients.
From recovering plastic containers to shipping products / Proposed System
The speaker design process started by acquiring different affordable speaker drivers and testing them. Each of them threw a different frequency until the balance between sound quality, volume and bass was achieved. These sketches reflect the evolution on the design configuration.
Prototyping Exploration
Sound Unit

Left / Different types of speaker drivers. From $0.85 to $2.00

Top Right/ Small paper cone experiment to amplify sound.

Amplifier connected to one of the first structures for holding the speaker inside the plastic container.

Even though different materials were testing to change the sound, as fabric and cardboard inside the plastic container, the initial testing did not trigger a good quality of bass or a good volume.
The idea of this design was to elevate the speaker's main axis to an average user's ear height when located on a desk. For the shape I was trying to achieve a friendly and easy to assemble body. The diameter of the three wooden legs would have to be the average pen diameter, so the user can replace a broken leg with a pencil or a pen.

A molded pulp cone plays the role of amplifying the sound. This material is biodegradable and the technology for manufacturing it broadly available. The color pieces are 3D printed pieces. Although being two pieces the printing process was slow enough to drop the idea.

After the Thesis pre-defense, I got in return, as part of the feedback, that some of the designs still had too many pieces. Some of them could be simplified. So I decided to start simplifying the speaker. Instead of having 10 pieces (including the cable) for assembling the speaker, I tried to reduce that amount to around 5 or 6.
While I was trying to figure out different possibilities to improve the sound of the speaker I remember a street drummer I saw in Boston during the summer of 2014. Street drummers use plastic containers without any modification whatsoever. This means that there is an acoustic quality that I was missing from these recovered elements.

Design Improvements
- Reduce the amount of pieces
- Improve volume and bass quality

What I needed to do was to create an inner structure that can hold an acoustic speaker against the cardboard cone. This would transfer vibrations towards the plastic container producing bass and volume.

A folding structure that creates tension and can be stored inside the plastic bucket.
The design of the 3D printed base provides the main structure for holding the plastic bucket with stability. The base snaps onto the plastic bucket similar to the battery cap in a remote control. The driver that provides enough vibration for this design is a 2” Boston Acoustic Speaker, 4 Ohm Impedance, Cost: $1.75. (Source: Allelectronics.com)

Testing and corroborating the improvement on the new design.
First Design Proposal / 9 pieces and low volume

Second Design Proposal / 5 pieces + better sound
The snapping system between the base and the bucket was changed in order to avoid the elastic strap that was holding the plastic container in place (Left picture).

Two speakers can be connected to an amplifier to get stereo sound.
The idea behind this product is to offer a place to keep books and other objects handy when working on a desk or a table.
Different comfortable heights were noticed during the research, corresponding to the different sizes of people that were interviewed. Another important factor that had effect on the decision of the legs’ length that all the pieces should be able to be stored inside the bucket.
**Last Design Stage**
Storage Unit

- Top left / all the pieces required to assemble the desk-side book stand
- Top right / user assembling the product
- Left / Last stage on the design of the desk-side book stand
Through testing the structural strength of the big container I came out with a limit of 165 pounds. The square based bucket is not able to handle more weight than that. Hence, is not going to be marketed as a stool for adults. The use of this container will be to make a stool for kids. The base, which keeps the container elevated from the floor, is made out of PVC tubes and PVC “T” joints. The reason of using PVC is that only belt saw is required to cut the pieces in appropriate segments.
During the experimentation with physical models the focus was in the simplicity of the assembly process and stability. User testing showed that the design needed a cushion in order to be an look more comfortable. The sharp edges on the bottom of the container make it difficult to seat on.
Kids can play assembling and disassembling the stool and using it. This will give them the early experience of building something that they can actually use, due to its scale. Following the principles of the other products, it also allows to store the pieces inside the main container.
During the ideation stage, I was pursuing the goal of having just one or two pieces that would allow the user to build a lamp, using the small plastic bucket as a shade. This plastic is able to diffuse light from a lightbulb.
At some point during the concept design I reached to this idea of a lamp: 3 wooden legs and one 3D printed link. But it looked boring and the main link was hidden, so I decided to keep exploring.
For creating an inner space in which electric pieces can be put I decided to have a PVC “T” joint. But the downside on this proposal is that it required three 3D printed pieces, this means a slow printing time. On top of that, from the visual point of view, the “T” joint is challenging the importance of the bucket itself.

Finally, all the pieces were reduced to just one. The user only needs to plug the base in a perforated plastic container, twist the base 30 degrees and it is done, ready to use.
The last design of the lighting unit is the easiest to assemble from the whole set. Without instructions a person can assemble this unit in 20 seconds. The plastic container is made of Polypropylene, a material that, in this thickness can diffuse the light really well for reading or light up a room. It is recommended to be used with a 815 Lumens 11 W 120 V LED lamp. This lightbulb works with United States voltage.
Branding and Packaging Principles

The name responds to a strategy that museums often implement. They have programs called “Adopt an Object” in which the museum asks people to help them take care of their unique collection by “adopting one of their objets”. Each object can only be adopted by one person, so this is promoted as a unique and exclusive opportunity. So the name makes this reference to enhance how special these objects are, hoping that users will take better care when use them.

Taking advantage of the ‘protective’ quality of the plastic containers, the packaging is reduced to a minimum of material. Only a strip of recyclable cardboard is used for branding and product information purposes. This also helps to convey the values of the brand.

Instructions printed on the inner side of the cardboard strip

INSTRUCTIONS:
1. Plastic bucket
2. Base
3. Hanging strap
4. Speaker driver
5. Paper cone

3 sew on snaps
1 cable
Adopt a Product / Sustainable Everyday Functional Objects
Usability Testing

Different students from RIT were asked to assemble each product at a natural rhythm. The times of each person were written down.

Average assembly times

Night Lamp: \(3 \text{ min } 17 \text{ sec}\)
Desk-Side Book Stand: \(1 \text{ min } 45 \text{ sec}\)
Speaker: \(3 \text{ min } 17 \text{ sec}\)
Kid’s Stool: \(2 \text{ min } 49 \text{ sec}\)

Conclusions

Speaker assembly still requires improvements. The major issues people faced when putting the pieces together were hanging the driver from the cardboard strip and figuring out how the cable goes out of the shell.

The base of the Kids’ Stool was hard to tighten up, especially for girls. It needs a softer coupling feeling. The Night Lamp and the Desk-Side Book Stand were easy to assemble for most people. Something noticed was that some people required instructions and some other did not need them at all.
Production Cost Analysis

I did the analysis of the speaker just to have an approximate idea about cost, in order to calculate an estimate retail price. The same methodology can be applied in order to estimate the cost of the other products. Of course, the prices of other affordable speakers already currently available in the market had also influenced on the retail price decision. (See benchmarking chapter)

Estimate numbers were calculated in order to have an idea of production volume and costs, but based on current 3D printers’ speed. We can assume that 3D printing technology will increase its speed in a near future.

Analysis based only on the speaker

Time required for printing the base = 3 hs 50’
Material used, PLA plastic = 0.069 lbs
1 spool bundle weights two lbs = 29 pieces
Hence, $0.94 each piece

Cost of all pieces

$0.94 PLA plastic
$1.25 three sew on snaps
$ 0.00 Bucket
$ 0.80 3.5 mm cable
$ 0.60 cardboard
$ 2.00 speaker driver

Total material cost per product $5.60

Estimate Price $25.99 price

Estimate Numbers of Employees

Three to four people can undertake this business idea. While the company grows, more people will allow recovering more used material and the volume of production will increase.

After doing a research on desktop 3D printers I noted that there is an average cost of $1,000 dollars per machine. Hence, starting with six 3D printers in order to create some sort of production flow, means an investment of $6000 dollars; which is an affordable alternative when compared to injection molding machines, which some of them cost more than $100,000.

List of required tasks based on observation of local entrepreneurs: concept design, marketing and sales, communication, fabrication, equipment repair, cleaning containers, packing products, shipping, recover used ingredients’ containers among some others.
**Market Penetration Strategy**

The base of this line of products and this business idea is to develop affordable and appealing artifacts in order to reused plastic containers while creating a business.

In order to catch the target user, first, the focus should be the product and the user experience. The person who purchases this product should truly feel his/her contribution to this sustainable production. I believe this sort of projects, like launching this kind of business based on reused materials and giving them a new value are the kind of entrepreneurship that need to tell their story. Is not just about advertising the products like they function amazing, it is about communication the whole idea, the long terms benefits and does this affect the environment and people.

“Getting your story and point of view out is different than marketing your company’s products. Communicating your point of view is about telling a much more personal story—it is about you and your vision of how you intend to do something transformational through the company you are building.” (Feinleib, 2012)

Finding the right channels of communication:

For project’s funding the crowdfunding engine called Kickstarter is good alternative. Although, channels of environmentally friendly styles of life and green products have recently spread through the social network and gathered many followers: The Lexicon of Sustainability, Green on Facebook, Sustainable Living, Innovating for Sustainability are just some groups out there, each of them having thousands of subscribers. The idea can take advantage on these channels to get to a great number of people, although, it is true that anyone that see the idea can start manufacturing this products because the visual simplicity in the way they are made.

Therefore, it is a matter of developing a great customer experience. By achieving the right balance between the benefits of 3D printing technologies and the fact that you can send files for replacements, this company should make things easy for their customers and its catalog of products should reflect such values. Respond efficiently and in a innovative way.

Affordability is not just a well–known concept here, it is about calling for a big unattended group of potential customers. If you only reach to a selected group of people, your impact is so little that you are not really affecting the environment.
Conclusion

To project’s goal of changing people’s perception on how a new product should look like is a bit of a challenge. The fact that companies have been investing in smart ways tiny, but important, details, like the unboxing experience have transformed consumers’ expectations into paths that go the opposite way than sustainably.

Just a few people are aware of the no-packaging movement, in which people take their own bags and containers to the store and commodities are sold by weight. And the main reason is that being green is not easy. The environmentally friendly option is always overshadowed by a more comfortable one.

Analyzing the whole experience of my Thesis made me think that creating appealing and functional objects made out of recovered plastic containers is possible. In the future, more recovered elements can be added up to the project and thus, more materials can be rescued from their way to the landfill.

Not only that, I have also received good feedback from people that have not been following me through the whole Thesis project, especially during my Thesis exhibit show, on April, 2015, at the Bevier Gallery (RIT).

I recognize that each of the products I designed still need improvement in order to go out and compete with durable and strong everyday conventional objects. Some conventional furniture and lighting units last for decades and are even passed by through generations. That was the reason of make them easy to repair, if it is noted that the user is not able to fix it by himself or if they are having difficulties, that is the moment in which the company will respond with affordable replacements.

Finally, I believe if this business model is taken to reality, and if the company’s efforts in pushing everyday life toward a Sustainable Future, in which material resources are managed in a more thoughtful way, be perceived by their users as honest goals, the business may succeed.
References

Books


Journals


Web pages


Films

Composting involves collecting organic waste, such as food scraps and yard trimmings, and storing it under conditions designed to help it break down naturally. This resulting compost can then be used as a natural fertilizer.

Energy Recovery from Waste is the conversion of non-recyclable waste materials into useable heat, electricity, or fuel.

Landfills are engineered areas where waste is placed into the land. Landfills usually have liner systems and other safeguards to prevent polluting the groundwater.

Reassess: Means to consider something again, especially if new factors have come to light since you first assessed the issue.

Recycling: Refers to the series of activities by which discarded materials are collected, sorted, processed, and converted into raw materials and used in the production of new products. Excludes the use of these materials as a fuel substitute or for energy production. (National Recycling Coalition, 1995) - From Measuring Recycling Guidance Glossary (Source: EPA official web page: http://www.epa.gov/)

Source reduction: or waste prevention, is designing products to reduce the amount of waste that will later need to be thrown away and also to make the resulting waste less toxic.

Uplecycling: reuse discarded objects or material in such a way as to create a product of a higher quality or value than the original.

Transfer Stations are facilities where municipal solid waste is unloaded from collection vehicles and briefly held while it is reloading onto larger, long-distance transport vehicles for shipment to landfills or other treatment or disposal facilities.

Glossary:

- **Composting** involves collecting organic waste, such as food scraps and yard trimmings, and storing it under conditions designed to help it break down naturally. This resulting compost can then be used as a natural fertilizer.

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- **Transfer Stations** are facilities where municipal solid waste is unloaded from collection vehicles and briefly held while it is reloading onto larger, long-distance transport vehicles for shipment to landfills or other treatment or disposal facilities.
An important but little explored aspect of sustainable product design is a reassessment of our scales of production so that products can be made, repaired and reused within an industrial ecology of cyclic resources use at the local or regional level.

Stuart Walker, 2006