Design for Repurposing

A sustainable design strategy for product life and beyond

by

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Abstract

As a society we are running out of resources and the number of products discarded everyday is no longer sustainable. How can design facilitate a solution to this problem? *Design for Repurposing*, presents a new strategy for incorporating the concept of repurposing in product design, which aims to extend the longevity of products by intentionally designing features or details that facilitate repurposing. Repurposing is the transformation of products or their components to suit a second purpose after their first has expired. For example, an old truck's wheel rim is transformed into a grill by welding iron legs onto it.

I explored the concept of designing for repurposing by interviewing, photographing and observing how people in developing countries, such as Mexico, transform existing products into different objects for other uses. I translated these observations into a detailed artifact analysis with reflections on what makes certain objects attractive or suitable to those who repurpose them. Design for repurposing converts consumers into engaged users who invest time to transform and customize products, thus easing the amount of waste in landfills and saving energy, money and the environment.

The new purposes assigned to products can be classified into three categories: planned, coached and open-ended. These categories share a common goal: to extend the longevity of an object's use. Repurposing also happens at different scales, such as batch production, and individual level (Do it Yourself: DIY). My thesis contains descriptive information and two checklists for designers, manufacturers and engineers seeking another strategy for sustainable design.

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List of abbreviations

CAD	Canadian Dollars
CD	Compact Disc
DFD	Design for Disassembly
DIY	Do It Yourself
GEM	Global Entrepreneurship Monitor
HDPE	High Density Polyethylene
LFMR	Landfill Mining and Reclamation
NID	Non-Intentional Design

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Introduction

> Given the growing levels of environmental degradation around the world, few would argue that we need to take a more ambitious and longer-term view of how products are designed, manufactured, utilized and disposed of. The need for fundamental change and thinking in relation to the design process and its outcomes cannot be overstated in any discussion about sustainability. (Lewis, Gertsakis 15).

The main topic of this thesis is a design strategy called Design for Repurposing. It incorporates the concept of repurposing in product design, which aims to extend the longevity of products by intentionally designing features or details that facilitate repurposing. Repurposing is the transformation of products or their components to suit a second purpose after their first has expired.

The reader will not find within this thesis a guide or examples of "Do It Yourself Repurposing," nor fashionable objects, nor ways to be kinder to the environment. Nor will the reader find detailed accounts of material analysis, life cycle assessment or processes/programs to move towards a more sustainable future. Clearly, other researchers/designers are already occupied with these ideas. My focus is on a new strategy for designing second life possibilities for objects that currently end up in a landfill. I am concentrating on what the authors of the book Okala: learning ecological design call *Design for second life with different function*. As Louise St. Pierre argues, "there is room to research every single [design] strategy greater in depth"(38), but to the best of her knowledge, nobody is working on design for repurposing (St. Pierre Interview).

One of my goals is to provide accessible information on repurposing for industrial designers, engineers and manufacturers. This information can be used as a resource when designing new products. As for my methodology, it includes research that is not only based on rational arguments, precedence and literature, but is also the result of interviews, tacit

knowledge, design for assembly and disassembly experiments, iterative prototyping and lived experience. I am very aware that my approach to sustainable design has been informed by my personal background. These thoughts and arguments sometimes overlap and, in the process, they are reinforced. Occasionally, they may even conflict, but I consider that these points of difference, too, can be useful and instructive:

I have structured this thesis into eight chapters in which the argument progresses from broad, general issues to progressively more detailed design specifications.

- In Chapter 1, “The problem,” I look at the existing state of cradle-to-grave designs, the amount of waste generated by these products and the current environmental crisis. I argue for reconsidering of our understanding of design for sustainability.
- In Chapter 2, “Repurposing in context,” I define repurposing as a common practice, trace its history, and compare it to other strategies such as thermal recycling, non-intentional design and reuse, and make the case for seeing design for repurposing as another strategy to consider. Because most people tend to use these interchangeably, I describe their particularities in this chapter. I also make the case for seeing repurposing as a positive practice, where discarded objects are transformed in something different in order to serve another purpose.
- In Chapter 3, “What is Design for Repurposing,” I incorporate the concept of repurposing in product design, as an evolved and positive strategy called Design for Repurposing, which aims to deal with the objects we discard of everyday.
- In Chapter 4, “Design for Disassembly,” I describe design for disassembly as a strategy that considers the future need for a product to be repaired,

refurbished or recycled, facilitating its assembly and disassembly. For design for repurposing to be successful, products have to be designed for disassembly first.

- In Chapter 5, “Mexico Artifact Research,” I briefly narrate the discoveries I made during my summer internship in Mexico. I describe artifacts designed out of cast-offs that respond to their owners’ needs. As well I highlight the features or characteristics that make those objects suitable for repurposing. (Subsection 5.1, is an in-depth analysis of these artifacts and their features).
- In Chapter 6, “How to Design for Repurposing,” I translated the criteria obtained from the artifacts’ study into two checklists which are based on criteria I obtained from the artifacts’ study, and repurposing potential scale. These checklists intend to be used by designers when designing new objects with a second life in mind: the first one intended for batch production; and the second one for Do it Yourselves.
- In Chapter 7, “Design for Repurposing Categories,” I break down Design for Repurposing into three categories: planned repurposing, where the designer has most likely planned the object’s second life; coached repurposing, where some repurposing suggestions are included; and open-ended repurposing, where the designer acknowledges that the repurposer will take over and do whatever s/he wants with the object.
- In Chapter 8, I discuss “Good Design for Repurposing,” and compare it to current good design standards. I call for the need to rethink our current understandings of good design.

The Problem

> We cannot solve the problems we have today by thinking in the same way that we did when we created them. Albert Einstein.

The mass produced objects that surround us shape our lives. They have brought what is perhaps the peak of human comfort to those who can manage to pay for them. However, in a world that is facing global warming, environmental degradation and running out of resources, the way we design and manufacture products is not sustainable. Most products are discarded before they are physically worn out or are technically obsolete because their design is no longer fashionable or appropriate to current circumstances. These products are victims of *obsolescence*. Obsolescence is a natural outgrowth of the capitalism. It occurs when a user no longer wants an object, even though it may still be in good working order. It frequently occurs because a replacement has become available that is superior in one or more aspects. Good examples are audiocassettes. Their mass production began in the 60's in Germany and declined with the introduction of the CD (Compact Disc) in the 80's ("Cassettes"). Like audiocassettes, many products in good shape and perfectly working end up in landfills. "Landfills around the world swell with fully functional appliances –freezers that still freeze and toasters that still toast" (Chapman 26). On the other hand, *planned obsolescence* is a strategy where companies deliberately introduce obsolescence into their products, with the objective of generating long-term sales volume by reducing the time between purchases (White). One example is the automobile industry, which every year releases new and appealing models with innovative features, colors and technology that draw consumers to purchase them. However, these vehicles are designed to wear out within approximately five years from their purchase, pushing consumers to replace them after that period of time. "Ours is a consumer society that profits from disposability under the logic that the sooner things break the sooner they can be

replaced. […] Since the 1930s, manufacturers have been designing their products to be replaced frequently just as fashion designers keep us buying by making last year's fashions look outdated" (White). People acknowledge that contemporary products don't last as they used to. Some of them try to keep their objects in a working order by replacing essential parts. However, in the developed world it is often cheaper to buy a new version of the same appliance (even if it is more expensive) than to pay someone to repair the original item. Even if we design products to last longer, we still tend to be working with a *cradle-to-grave* paradigm.

McDonoungh and Braugart, define this model where "resources are extracted, shaped into products, sold, and eventually disposed of in a "grave" of some kind, usually a landfill or incinerator" (28). Because not everything is recyclable or reusable, most garbage goes to *landfills*. Landfills, or dumps, are sites for the disposal of waste materials by burial. They can be regarded as abundant sources of materials and energy. In the developing world, this is widely understood. Raw materials such as iron, aluminum and wood are imported to China, and assembled into appliances for export to the West. Then, these products return as recyclable junk to small Chinese villages where poor peasants rummage through mountains of electric irons, cords, telephones and computer waste, collecting recyclable materials from computer motherboards, keyboards and monitors whose toxic contents eventually seep into the ground and poison the water (Manufactured Landscapes). In a commercial context, companies have also discovered landfills sites and many have begun harvesting them. *Landfill mining* and reclamation (LFMR) is a process whereby solid wastes, which have been previously buried, are excavated and processed. Processing typically involves a series of mechanical processing operations designed to recover one or all of the following: recyclable and reusable materials, a combustible fraction, soil, and landfill space ("Landfill Mining"). It is clear that burying waste and harvesting it is not

sustainable or viable. While LFMR offers a supply of materials that can be reprocessed or repurposed, it is an inefficient point of exchange. My intention is to advocate another method that supports a point of exchange of materials before they end up in a landfill, or even not landfilled at all.

It is likely that, in Canada and the U.S.A., the amount of consumer goods we create and dispose of is constantly increasing because:

- People are buying more products and disposing them quickly.
- Increasing population means that there are more people on the planet that buy products.
- Fashionable lifestyles encourage buying trendy products that we don't really need, which means that we create and dispose of additional waste.

It is apparent that the world needs, and would definitely benefit from another solution/strategy for all those objects that are being disposed of every day. In the next chapter I describe repurposing as a practice, and some of its closer relatives.

Repurposing in Context

Before jumping into what design for repurposing is, it is important to first understand what *repurposing* stands for. Repurposing is creating a new or a second life for an existent product by making some transformations to it. It is a common practice. People have been transforming things in ways that were not originally envisaged since they began appropriating objects. This phenomenon goes far back in history, back to the beginnings of object culture. At least as early as the Stone Age, people began using material found in nature with the strategic goal of improving their chances of survival.

Large scale repurposing of existing objects can also be observed during times when a population experiences a shortage of products or materials. A good example of this is the Post-war period in Germany, described in Design by Use. Some objects experienced a significant transformation when it came to meaning. *Guter Rat fur Haus und Kleid (Good advice on housing and dressing)* was a magazine set up immediately after the war, providing patterns for children's clothing made from uniforms, manuals for the construction of cooking boxes out of discarded aluminum, among others (Brandes, Stich, and Wender 42).

Repurposing was not confined to post-war Germany. The use of Coca Cola in some countries is another example of total transfer of function and meaning. In Russia, women use it to smooth wrinkles. In the Japanese Island of South Ryukyu, the Coke bottles are seen as symbols of luck, and now are placed on altars. Due to their round belly shape, they have replaced ceramic figures of pregnant women (43). In Mexico we use Coke as a drain cleaner, and it really works. These objects are taken out of its original context/purpose/function and transformed and used in a different environment for purposes that for many seem to be "wrong".

There are design studios around the world that are already using discarded objects and transforming them into new objects: Studio Campana in Brazil, Resource Revival in USA and Reestore in the UK, among many others. Also, Readymade and Real Simple are examples of some of the many magazines that highlight other uses for everyday objects. However, none of them are addressing the design of objects from scratch, to make them suitable for repurposing once they become obsolete or broken.

Repurposing needs to be understood in comparison to some other practices. The commonly understood definition of *recycling* is to collect similar materials and reprocess them into new products; some examples of recycled products are egg cartons and toilet paper, among others. According to Ann Thorpe, author of The Designer's Atlas of Sustainability, "most recycling actually degrades material quality resulting in 'down-cycling': with each recycle, the materials lose structure and concentration" (42). Recycling is often thought of as the great solution for unwanted or broken objects and materials. However it comes with a number of disadvantages, such as the need to reprocess the original material and the energy required to accomplish this task. *Thermal recycling* involves incinerating the waste materials (mostly metals and plastics), while chemicals are added and toxins are released, and "even the new product can release more toxins during use" (McDonough and Braugart 40). As well, it takes fuel to transport the discarded products to the reprocessing plant. In contrast, repurposing does not involve the reprocessing of the material.

Repurposing is a closer relative to *reuse*. It means, "to use an item more than once". By taking useful products and exchanging them, reuse helps saving time, money, energy and resources. An object is passed along, but used again for the same function, without suffering any transformation. A sweater passed onto a sister is one of many examples.

Non-intentional design (NID) is using objects not only in traditional ways, but also in new contexts without any deliberate design intention. “People are faced with a situational problem that they have or want to solve” (Brandes, Stich, Wender 56). A chair used as a coat rack, a table used to sit on, are examples of non-intentional design. In this context, we can observe that similar objects are used for the same purpose, even if they were not created to fulfill the same function. For instance, in many households, Mason jars – glass jars used in canning to preserve food- are constantly used as drinking glasses (Fig.1). It is unlikely its creator, John L. Mason, in 1858, anticipated this use.

Fig.1 Aguirre, Darinka. Mason Jar. April 25, 2009

After analyzing the previous strategies, it is clear that repurposing offers benefits that could be observed in multiple ways:

- *Repurposing saves energy.* The amount of energy consumed when repurposing is minimal compared to the energy required to acquire and transport raw materials from their source. Also, the energy destined to recycle objects or their components is saved.
- *Repurposing preserves environmental conditions and reduces pollution.* Repurposing helps the environment by minimizing the energy spent on industrial production. Minimum amounts of energy are used when repurposing. It reduces the need of processing raw material in recycling (which creates toxic material that pollute the environment).

- *Economic benefits*. Repurposing saves money demanded for the production of new products from raw materials. These expenses include the entire production cycle starting from acquiring the raw materials, transferring them from their origin to production places, processing, manufacturing and disposal costs.
- *Repurposing eases the need of space for waste disposal.* Most of the landfill sites are filled up with a lot of waste products. Some of these waste materials belong to non-biodegradable objects, which take a long time to decompose. Repurposing avoids discarding objects by expanding products longevity.

So far we know that repurposing is a practice in which objects are transformed into different things from their original purpose, and that repurposing has different environmental and economic impacts than recycling.

Therefore, what is design for repurposing?

What is Design for Repurposing?

Design for Repurposing sets the conditions for repurposing. It is an evolved design strategy that proposes that it is possible to design a product with qualities, features and details that facilitate repurposing. Through the course of my research, I identified artifacts that are easier to repurpose than others, and detailed those qualities and features that supported the eventual repurposing (see chapter 6 for the checklists). I propose that with this understanding, it is possible to design to enable future repurposing, even though the conditions of repurposing are not fully known in advance. When designing for repurposing, the designer does not necessarily control or direct the ultimate repurposing, but only sets the stage for possibilities. In this way, design for repurposing and the act of repurposing are distinctly different acts.

Design for repurposing aims to deal with the abundance of products we discard of everyday (as long as they are not designed already for composting, reusing, or represent any kind of danger to human beings), and where the original materials are not necessarily reprocessed. In the original design, products are intentionally given qualities that facilitate their transformation into another product with different purpose/function once their first life span has expired. The main goal of this strategy is to extend products' longevity.

In contrast to the Mason jar example cited in the previous chapter, the designers of the Nutella jar (Fig.2) most likely planned its second life. The clarity of design indicates a purpose: once the product is consumed, the jar becomes a drinking glass.

Fig. 2 Aguirre, Darinka. Nutella Jar. March 19,2009

However, it is nearly impossible for designers to anticipate what the second life or purpose of the object would be once the repurposer takes over, and certainly, not everything can or should be repurposed. There are items that represent potential dangers to our health because of their toxicity, or because they are designed specifically to be used only once and not to be manipulated or transformed into something else. Examples like surgical needles and personal items come to mind.

As an industrial designer I can see that there is a latent opportunity to facilitate repurposing in most objects, which would lead to many positive benefits for both the earth and people. I strongly believe that this strategy, especially in the industrialized countries, would be very welcomed.

Shedroff in Design is the Problem, states, “It is not enough anymore to simply design better, more durable products. In order to be truly sustainable, solutions need to both last longer and have a life after their normal use period” (176).

In the following chapter I introduce Design for Disassembly as a key facilitator for repurposing.

Design for Disassembly

It is clear that we may not be able to sustain our current lifestyles for long without considering the environmental impact this has on the planet. Long-term sustainable solutions are needed. Design for repurposing is one of them. However, in order for repurposing to be possible, products first have to be designed for disassembly. *Design for Disassembly* (DfD) is an example of a deliberate strategy originally to facilitate recycling and reuse, although it also facilitates repurposing. It is one of the strategies designers and manufacturers are currently employing to design with more responsibility. DfD involves designing a product to be disassembled for easier maintenance, repair, recovery and reuse of components and materials (Chiodo). This disassembly process can be performed by automated machinery, such as robots, or manually. However, manual labor does provide jobs.

Implementing DfD into a new design allows the product and its components to be better suited for reuse or recycling when it has reached its end of life, thus reducing the quantity of resources required to create new products. Some electronic appliances companies such as Panasonic and Philips are known for using DfD during product design, shortening timescales and reducing development costs.

According to Gertsakis and Lewis, authors of Design + Environment: A Global Guide to Designing Greener Goods, design for disassembly makes the product easier to repair and refurbish when needed (86), by

- Minimizing the number of separate components
- Avoiding glues, metal clamps and screws in favor of "push, hook and click" assembly methods (e.g. snap fits)
- Making fasteners from a material compatible with the parts connected

- Designing interconnection points and joints so that they are easily accessible for the opening, loosening or separating of components by hand
- Designing the product as series of easily accessible “blocks” or module
- Using in-mould identification symbols for plastic resins (based on ISO 11469 [ISO 2000])
- Minimizing the number of different materials used
- Locating non-recyclable parts in one area that can be quickly removed and discarded
- Locating parts with the highest value in easily accessible places
- Ensuring that assembly and disassembly can take place with simple tools
- Standardizing as many elements as possible, thus avoiding tool changes during assembly and disassembly
- Keeping assembly and disassembly methods to a minimum so as to improve efficiency
- Ensuring that fixings and fasteners are easily accessible
- Keeping the number of fixings and fasteners to a minimum
- Designing for ease of separation so that damage to components is eliminated

Complex products such as Herman Miller chairs use similar DfD guidelines. Since 1991 Herman Miller has been stamping product parts, identifying what types of plastic they are, and which ones can be recycled (thermal recycling). Often, complete instructions for disassembly are provided (“Herman Miller”).

However, there are high-risk products where disassembly is better left to trained people, such as medical devices, high-voltage electronics, and automobiles.

Design for Disassembly increases the effectiveness of Design for Repurposing. For instance, products designed for manual disassembly for repurposing facilitate the work of the repurposer. S/he is able to more easily take apart all the components of an object and make use of most them. Victor Papanek, author of The Green Imperative: Natural Design for The Real World, states “It is likely that the customer will learn more about the product, and be able to make simple repairs after having put it together; this will also lessen the alienation between tool and user, and allow improvisation and improvements on the workings and aesthetics” (244). In a similar way, DfD can facilitate repurposing.

“It is not too difficult to design more easily disassembled products when it is part of the initial phase of the design specification and goals. However, once engineering, design and production are already decided, it is nearly impossible to redesign for disassembly” (Shedroff 185).

Now that DfD has been explained, what if, for instance, we could divert four components from an object (let’s say a chair) that was designed for disassembly for recycling (as mentioned earlier, recycling is problematic), and instead repurpose them? What about ten components from the same chair? I believe that the environmental impacts would be very significant, because, as I explained in chapter 2, repurposing has several advantages over recycling: consumes fewer resources, is less intensive and expensive, and releases fewer toxins from thermal processes.

Mexico Research

For the purpose of this chapter it is important to clarify that the context of Design for Repurposing, such as cultural and social conditions and circumstances, is undetermined. Innumerable examples of repurposing can be found all around the globe. It happens in many different places, at different economic strata. Therefore, I am not doing a critique of Mexico versus the developed world in the sense *that Mexicans repurpose almost anything while richer countries don't*. That topic is for another paper. However, it is important to acknowledge that, indeed, there is a correlation between economic status and repurposing. The examples described below were compiled during my internship in Mexico and are part of my inspiration for Design for Repurposing.

Born and raised in a privileged position in Mexico, I observed (rather than directly experiencing) how marginalized people meet their needs with what is available. I have been particularly interested in this practice, because, in Mexico, as in many other low-income countries, waste represents an available resource. For someone making $4 CAD a day there is, in effect, no choice but to make do with what one has. "Affordability isn't everything; it's the only thing" (Smith 9). For these people, repurposing does not seem to arise out of ecological awareness; nor does it represent a spontaneous act. Instead, it is the way they survive.

During my summer internship, I spent two and a half months researching, taking photographs, filming and interviewing people from twelve communities and three major cities in Mexico. I did this in order to know better their motivations, considerations and limitations when "designing" objects with cast- off materials. I also wanted to find out what makes some objects more *repurposable* than others. I am interested in learning how could I apply the knowledge of these qualities in my practice, and helping others understand how to

apply this knowledge when designing to support the eventual repurposing of artifacts.

The objects I selected to describe in this chapter (all from Mexico) are the most interesting in matters of shape, function and repurposing possibilities. A more detailed description of these objects can be found in the subsection called *Artifacts Analysis* after this chapter. These objects are intended to open a discussion about the specifics of repurposing.

Artifact A. Sink-grill: Mr. Humberto Mijangos, a retired worker from the oil industry, transformed an old single-bowl stainless steel kitchen sink into a charcoal grill. He designed an iron structure, a cooking grid, and a removable cap, which fits the sink's hole at the bottom for disposing of the ashes (Fig.3).

Fig.3 Aguirre, Darinka. Sink-Grill. June 12, 2009

It is important to acknowledge that, like Mr. Humberto, many people in Mexico have the skills, the equipment and the tools to achieve these transformations. Since welding is a common practice, especially in small cities and rural areas, people come up with interesting creations, giving discarded objects a 'second chance' while saving money and meeting some of their needs.

Artifact B. Washing machine drum (multiples): I also discovered that the most common designs in the area I traveled through were cylindrical-shaped washing machine drums transformed into planters (Fig.4). They were everywhere. Their large number (I observed 60) suggests that there's something about their original design that calls out to users to transform them. It was the sight of all these transformed washing machines that inspired further research into what makes an object good for repurposing.

Fig.4 Aguirre, Darinka. Washing Machine Planters. June 22, 2009.

In answering this, I look to J.J. Gibson's "Theory of Affordances" explained in the book The Ecological Approach to Visual Perception. Gibson defines *affordances* as "the capacity of objects to talk to the user in an intuitive way" (127). Donald Norman, in the book, The Psychology of Everyday Things, describes the term *affordance* as "the perceived and actual properties of the thing, primarily those fundamental properties that determine how the thing could possibly be used" (9). What both authors mean by *affordances* is that people do not need a manual in order to interact or to know what to do with certain objects. Its

capabilities are revealed to us. “Complex things may require explanation, but simple things should not. When simple things need pictures, labels or instructions, the design failed” (Norman, The Psychology 9). The washing machine drum proves Norman’s point. The main affordances in the washing machine are its size, its capacity as a vessel, and its resilient material. The person that came up with the planter idea probably identified the former characteristics without a great deal of analytic thought, and chose this object for its ability to transform. Therefore, more people recognize washing machine drums affordances and now are they seen in many Mexican gardens and sidewalks. In the subsection entitled “artifacts analysis” I give a detailed examination of the affordances offered by the artifacts described in this chapter.

Artifact C. Rim-grill: Another interesting example of affordances is found in Mr. Victor Blanco’s repurposed objects (Fig.5).

Fig.5 Aguirre, Darinka. Mr. Victor Blanco’s Repurposed Objects. July 3, 2009

Mr. Blanco has his own blacksmith shop at home and repairs cars and kitchen appliances as a way of living. Like Mr. Humberto, he transformed a car’s wheel rim into a chair, a gas cylinder into a stool and a truck’s wheel rim into a charcoal grill. Thinking further

about affordances, I observed these objects in relation to the attributes that would make them simple and feasible to transform into things he needed.

Fig. 6 Aguirre, Darinka. Rim-Grill. July 4, 2009.

For instance, the main affordances in the rim-grill (Fig.6) are its size, its material, which is durable and resilient enough to withstand extreme temperatures, and its contours that allow a cooking grid –which he also designed for this purpose- to rest on it.

It is important to acknowledge that the conditions and motivations that promote repurposing vary according to the context. It seems that for low-income countries like Mexico, repurposing possibilities are closely connected to the tools that people own.

For the citizens of Mexico, most repurposing happens mainly out of

a. *Need/survival (in some cases):* In the article “Maquila Workers Can’t Meet Basic Needs on Plant Wages”, “in Matamoros, a family of four needs $193.86 pesos ($15.69 CAD) a day in order to have a sustainable living wage” […] “In conformity with payrolls from a number of workers, most of them make less than $55.55 pesos (approximately $4.49 CAD) a day. One minimum wage salary in Matamoros covers just 19.6% of what a family of four needs to carry on” (Ramírez). Consequently, many Mexicans are forced to repurpose and repair what they have since their possibilities of buying new are few. Their belongings have to last as long as possible.
b. *Entrepreneurship:* In reference to the Global Entrepreneurship Monitor (GEM), “entrepreneurship proliferates in Mexico but is concentrated among low risk, low value added activities that require minimum investments of capital. Due to economic realities, people are relatively unable to leave existing employment to pursue high risk ventures”. […] Mexicans “select opportunities that can be tested quickly and have relatively high success probabilities and modest up-side potential with quick positive cash flow” (Beach and Hanks). This makes repurposing a well-suited opportunity for small entrepreneurs. Just as Mr. Victor Blanco repairs cars and electronic appliances, many people repair, repurpose and refurbish objects and sell them for living.

In contrast, in many high-income countries, repurposing generally happens out of

a. *Curiosity/originality:* Besides environmental awareness, repurposing in richer countries is seen as a statement of creativity. There are plenty of Do It Yourself (DIY) publications that show how to make original stuff with trash.

For instance, gardening scoops out of empty PET (Polyethylene terephathalate) bottles and hanging lamps out of wine bottles, among others.

b. *Entrepreneurship:* There is a rising trend that promotes shopping for earth-friendly or green goods, since a large number of consumers are demanding them. “About 12% of the U.S. population can be catalogued as *true greens*, consumers who seek out and regularly buy so-called green products. Another 68% can be classified as *light greens*, consumers who buy green sometimes” (Hanas). It is important to acknowledge that most of these expensive and stylishly designed products are displayed in boutique-like stores. A lot of them are made out of fibers and natural materials while others are made out of cast-offs. In many cases the number of these objects is limited and repurposing becomes craft.

c. *Legislation:* While repurposing as a strategy is not being legislated, the increasing legislation around producer responsibility will provide more motivation for all types of recycling, repurposing, and reusing. Germany has led the way with take-back legislation, and Canada and the US are following suit.

As a result of this study, I became aware of the fact that many everyday objects have attributes or affordances in their design that are rarely if ever considered by their designers in the initial design stages. However, people do identify these affordances as opportunities for creation. Here is the opportunity for design: to design and detail products to enhance the possibility that people will rework and reconfigure product components in unpredictable ways. “This means that designing as steering more than designing as shaping. From thinking of ourselves as the authors of a finished work, we had better evolve

toward thinking of ourselves as facilitators whose jobs is to help people act more intelligently, in a more design-minded way, in the systems we all live in" (Thackara 214).

Artifact Analysis

The following analysis gives a description of the artifacts mentioned in the previous chapter. The purpose of this examination is to evaluate the examples of repurposed objects mentioned in the previous chapter, in order to learn what characteristics make something repurposable. It will provide the reader more information about affordances based on how people use and repurpose objects. Three of the objects from Mexico are catalogued as functional. A fourth one as ornamental. Its purpose is to demonstrate that repurposing potential is everywhere, and can manifest in many different ways. In addition, I include one more example that is found in many high and low income countries and has strong obvious affordances for repurposing.

Artifact A. Sink-grill

This is a grill (fig. 7) made from a discarded kitchen sink. Due to the large number of benefits that it offers, stainless steel makes the perfect *material* for kitchen sinks. It is flexible, resilient, and malleable. Apparently, Mr. Humberto Mijangos identified these characteristics as suitable for transformation.

The basic form of the sink is a *vessel*. This is an easy invitation to make use of it. The flat *edges* at the top are crucial affordances since they allow the attachment of a lifting cooking grid through welded hinges. This cooking grid makes it easy to place the charcoal/lumber into it. Because both sides of the sink are identical, this *symmetry* or *balanced* proportions make it simple for the repurposer to weld a metallic structure (as well symmetric) made of iron rods to it. Symmetry means that an object is identical on either side

if divided by a line or a plane. As well, Mr. Humberto took advantage of a *hole* in the bottom of the sink by adding a removable cap for the ashes.

Fig. 7 Aguirre, Darinka. Sink-Grill. June 12, 2009.

Artifact B. Washing Machine Planter

It is said that if a washing machine is rumbling, and very noisy when spinning, it has a drum bearing failure. Drum bearing malfunction is common on many washing machines due to water getting into them if the drum bearing seal fails. Since there are washing machines of variable prices in Mexico, some of them very cheap (around $120-$150 CAD), they break down quickly and are widely available for repurposing. Many are transformed into planters.

As in the case of the sink grill, the drum has an obvious capacity as a *vessel*. The newest washing machines tend to have drums with a capacity for at least 6kg to even 9kg - 10kg. Washing machines' drums have tiny *holes* all around the perimeter. These holes are important affordances. They are small enough to hold the soil in place, and allow the excess of water to flow out, while providing aeration.

Material is also important. "Most washing machines are made out of steel coated with zinc to improve rust resistance". […] "On some models the drum is made of stainless steel". […] "All other models use a steel (called enameling iron) designed for porcelain coating" ("Washing Machine") This water resistant and long lasting material makes drums ideal as outdoor planters.

Furthermore, besides being a receptacle upon which, or into which, plants may be placed into, washing machine planters tend to be highly *decorative***.** In Mexico they are often used for large flowering plants or for the cultivation of small herb plants, or even for planting trees. People tend to personalize their planters. More affordances are its cylindrical *shape* that invites the addition of a standard base (Fig. 8), and their curved planar *surface*, which people paint or paste things on.

Fig. 8 Aguirre, Darinka. Washing Machine Planter. June 12, 2009.

Artifact C. Rim-grill

The rim-grill is a repurposed outdoor device for cooking food that uses charcoal as a fuel source. It is composed of a truck's wheel rim, an iron plaque, a supporting structure made out of rods, and a cast iron cooking grid (Fig.9).

Mr. Victor Blanco selected a truck's wheel rim to transform it into a grill due to its affordances. Its *material* (steel) can withhold hot temperatures, it is rust resistant and offers good weldability. Coming from a truck, its *diameter* is big enough for cooking. Along with its diameter, its *width* (separation distance between opposing rim flanges) and its capacity as a *vessel* are also features that make a good charcoal chamber.

However, since the rim was *hollow*, Mr. Blanco had to weld an iron plaque –which he also made- to the rim's lower flange in order to convert it in to a chamber. Its *contours* allow a cooking grid to rest on it. By welding iron rods onto it, Mr. Blanco created a four-legged supporting structure for his grill.

Fig. 9 Aguirre, Darinka. Rim-Grill. July 3, 2009.

Artifact D. Pelican Vase

Mr. Portilla turns High-Density Polyethylene (HDPE) detergent containers into ornamental artifacts. He makes vases, penholders, and decorative magnets, among others, which he sells at his butcher shop. His work with these represents an additional income for him. He has a dental unit at home, which he found in an alley and uses its drills and surgical cutting instruments as tools.

An HDPE container has three main affordances: material, vessel capacity, and its contours. Their *material* is harder and can withstand high temperatures compared to PET (polyethylene) bottles. It is *flexible* and *resistant*. It can be cut with simple tools such as stanley knives. Since it is already a *container*, Mr. Portilla takes advantage of this affordance by transforming it into a vase (Fig.10). On the other hand, it is probably not intended for living plants because it cannot hold a lot of water.

Contours are key components. They act as *guidelines* or paths for cutting. Mr. Portilla cut the pelican's "wings" following the containers' original contours. I believe its designer shaped the contours merely as aesthetic value (and perhaps to add rigidity to the thin walled vessel) and never anticipated this application. The coating applied on the object is spray paint for plastics, although acrylic paint could also do the job.

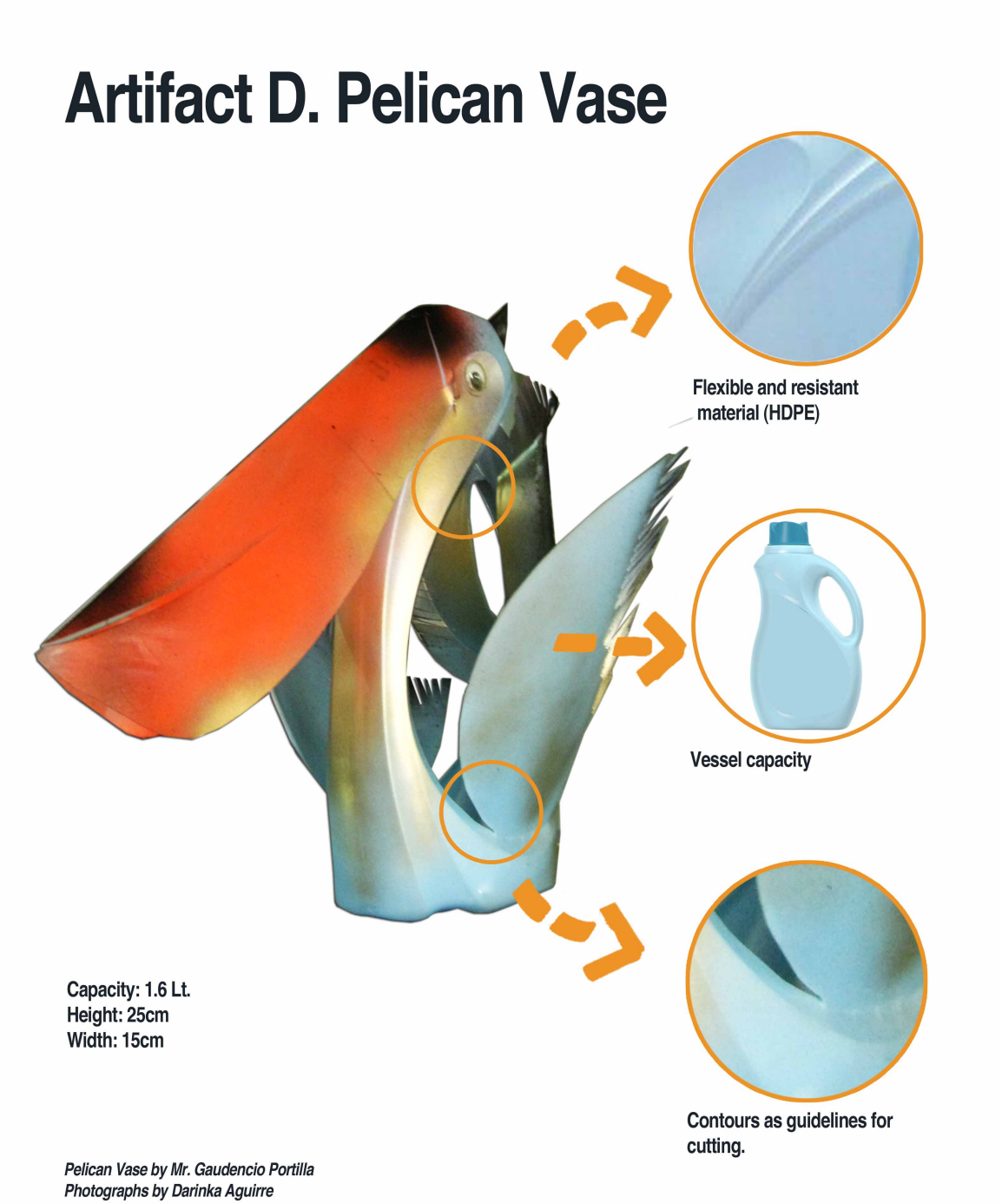

Fig. 10 Aguirre, Darinka. Pelican Vase. July 15, 2009.

Artifact E. Shopping Cart

A shopping cart is a cart supplied (mostly) by supermarkets and/or grocery stores for transporting goods to the check–out counter while shopping. Shopping carts have many affordances. Almost all carts are made of long lasting *materials*, such as metal or plastic. The artifact I am analyzing is a metal one, because I believe it offers more possibilities due its material and other components.

These carts have an iron tubular frame, a wire basket, a rear gate and lower tray with a gray-coated finish for added rust and corrosion resistance. Carts are generally fitted with four rubber *wheels*; two *swivel or rotating wheels* at the front, and two fixed orientation wheels at the back. These provide *mobility*, which offers an immediate functionality and easy portability. Like the sink, it is a vessel. It is not enclosed; it is an *open wire mesh* yet still it has a great *capacity for carrying*. Its open wire basket invites the user to *add* goods equally in the wire basket or in its lower tray. In addition, the open mesh invites the possibility of *hanging, tying***,** or *clipping*, things onto it. Carts can come in many *sizes*, with larger ones (Fig. 11) able to carry a child.

Its main iron wire basket offers several possibilities. It can be *cut* into smaller wire meshes following its *edges/contours*. These *meshes* could be used as material for other purposes. The *spaces* between the grid lines could act as *ventilation openings* if transformed into enclosures such as cages and storage bins.

Fig. 11 Aguirre, Darinka. Shopping Cart. September 15, 2009.

There are numerous visible examples for a cart's repurposing. "The carts, which cost between $75 and $100 each, have been used for such purposes as barbecue pits, go-carts, laundry trolleys and even shelters" (Wilkinson). Some design agencies, such as Reestore in the United Kingdom, repurpose shopping carts by turning them into pieces of furniture (Evans n.p).

Fig.12 Annie. Reestore: Contemporary Eco Design. 2001. 18 November 2009. <http://www.reestore.com/annie.htm>

"Annie" as they call it (Fig. 12), is a shopping cart transformed into a chair. The designers removed structure brackets from the rear meshes along with the handle bar. As well, they replaced the wheels with four threaded glides and folded some grid from the side

meshes to create armrests. These armrests are connected to the back of the chair by brackets (probably taken from the lower tray), providing support and strength to the structure. It is important to point out that all the materials, except for the glides, and of course, the decorative cushion, come from one single shopping cart. The basic tools used to achieve this transformation might have been pliers, bolt cutters and a hacksaw; some welding equipment was likely required as well.

Kevin Cyr's *Camper Kart* is a functional, movable shelter constructed out of a shopping cart. Although he claims to be a sculptor, his projects are functioning sculptural pieces. He investigates topics such as habitats and housing, recycling and ecology, exploration and mobility (Cyr).

Shaped like a Coleman camper, Camper Kart is large enough to fully enclose a 172.72cm frame. It has a retractable roof, a front and a removable back door, and storage space in both the upper wire basket and the lower tray. He added plywood panels to enclose the storage space. Two brackets are welded on both the left and the right sides of the shopping cart to support the plywood collapsible frame/platform.

Cyr probably chose the metal shopping cart instead of the plastic one, due its affordances: metal meshes that can be removed easily through basic cutting tools and welded as desired; its strength for supporting a frame (and the person who makes use of it); its resistant material and its carrying capacity.

All of the previous examples enable us to see how certain detailing provides specific affordances that enable repurposing. It seems that people detect certain affordances in a hierarchical order:

1. Vessel capacity: It is number one because it offers the possibility of holding something. Objects with this capacity act as containers (such as a bottles, cups, or buckets), enclosures, and storage spaces.
2. Shape: Shape determines what to do with the object. Usually it is the first thing that inspires the repurposer's imagination.
3. Material: It determines whether the object is suitable for transforming with available tools. For instance, some metals can be welded, rolled up, cut and punched, among other things. It also dictates its possibilities as future raw material.
4. Symmetry: Proportionality and balance offers an advantage over non-symmetrical objects. This means that the repurposer can divide the shape into two or more equal parts.
5. Dimensions: Size matters. Size can determine how the object can be potentially transformed. For example, it may be too big, too heavy or inaccessible to someone without appropriate equipment.
6. Flanges: Flanges allow other objects to rest or hang from them.
7. Holes: Holes allow repurposers to imagine how to connect, attach or introduce other parts or objects.
8. Profiles/contours: User can use them as guidelines to cut or fold areas of a product.
9. Mobility: The possibility of carrying. Portability.

I acknowledge that there are many affordances that are not discussed in this analysis. However I believe that it is enough to understand why affordances are important for products designed for repurposing. Cynthia Smith, author of Design for the other 90% states “the designer might only be able to give an object some general characteristics. The user takes over and designs himself in the sense that each use creates, or refers to, often that rather self-defined principles of order and interpretation, and dimensions of experience”(51). As designers we are not in control of how things are used or how are they repurposed. However, we can provide certain suggestions through affordances, as to how or what the product will be used or transformed into, and leave it up to the repurposer. I also acknowledge that in many cases, the repurposer has to do some work to take apart a product before s/he can discover its affordances.

“When affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction is required” (Norman, The Psychology 9).

In the following chapter I offer two checklists that could be helpful if designing for repurposing.

How to Design for Repurposing

In previous chapters, I established design for repurposing as an evolved design strategy that could help ease the negative environmental impacts in today's world.

But how do we design for repurposing?

In this chapter I am listing the criteria, features and affordances that enable repurposing framed as guidelines. These are listed in two checklists according to their repurposing potential scale. One intended for batch production, small-scale or cottage industry, and the other for individual scale.

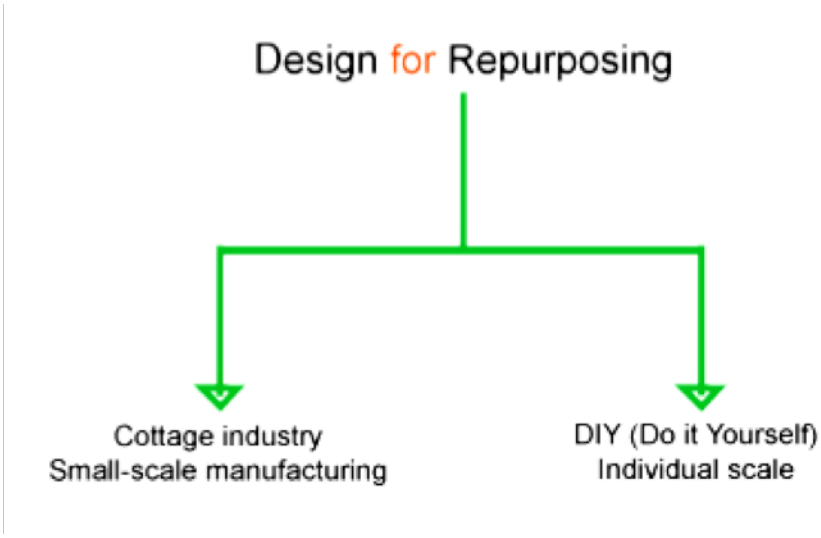

Fig. 13 Design for Repurposing Slopes

An aspect of batch production scale is that a steady supply of repurposable artifacts would have to be sourced and delivered to a production site. This can be facilitated by local municipalities. According to the Recycling Council of British Columbia (RCBC), in Vancouver BC, plans are underway to divert solid waste into particular streams and can be sorted and accessed by entrepreneurs (Macdonald Interview).

In the case of the DIY scale, design for repurposing connects to and supports the widespread movement of individuals who are wishing to modify objects and create their own products and environments. As mentioned in chapter 2, design studios, such as Reestore in the UK, and Studio Campana in Brazil, and some magazines and publications, such as Readymade, and Design it Yourself, are examples of the DIY scale.

	Design for Repurposing Checklist (Batch Production) ***Steps to get started***
✔	Designed for disassembly. This is a core value. For comprehensive information please refer to the guidelines in the chapter on design for disassembly. In brief, most of the components can be separated through simple processes/tools. If there are parts that won't be used in the repurposing process, they are suitable for recycling or reuse. These components are identified either by color, display tag or label.
✔	Durable materials. In products designed for repurposing, materials and components are durable and capable of functioning well in another role. It is ideal that materials are long lasting. For example, stainless steel is ideal because it is rust resistant.
✔	Affordances. The designer provides cues and clues. Some of them are: -Symmetry. If a shape is symmetrical, it can be divided into two equal parts. It also means repetition in sub elements, like the pattern of veins in wood, for instance. -Holes. Perforations or openings that allow to insert or pass things through them. -Contours/edges. Guidelines or patterns that could indicate possibilities, such as cutting, peeling, etc. -Flanges. Flanges act as resting surfaces, as limits or attachments for other objects, and as structure strengtheners. -Panels. Usually they refer to rectangular surfaces in an object. They can be used as raw material.
✔	Sharp edges. Sharp edges are design, situation or context dependant. In some cases they might be desirable, in some others they won't.
✔	Not hazardous. Products designed for repurposing strive to be safe, for instance, from toxicity. If perilous at any level, explanatory labels should be provided so that components could be easily removed.

	Design for Repurposing Checklist (DIY: Do It Yourself) ***Steps to get started***
✔	Designed for disassembly. This is a core value. For comprehensive information please refer to the guidelines in the chapter on design for disassembly. In brief, most of the components can be separated effortlessly and safely through simple tools, such as screwdrivers, pliers, hammers, etc. If there are parts that won't be used in the repurposing process, they are suitable for recycling or reuse. These components are identified either by color, display tag or label so the repurposer identifies them easily.
✔	Durable materials. In products designed for repurposing, materials and components are durable and capable of functioning well in another role. It is ideal that materials are long lasting. For example, stainless steel is ideal because it is rust resistant.
✔	Immediate functionality. Consider the possibility that some of the dismantled components might offer immediate functionality, such as containers, vessels, strainers, etc. Strive to retain that potential in the newly configured design.
✔	Inviting. The product invites the repurposer to transform it. Its engagement is partly informed by its material quality. It might also be appealing via its formal qualities.
✔	Easy and obvious. No explanations, if any are needed. The simpler, the better.
✔	Affordances. The designer provides cues and clues for the repurposer. Generally, affordances reveal themselves. Some of them are: -Symmetry. If a shape is symmetrical, it can be divided into two equal parts. It also means repetition in sub elements, like the pattern of veins in wood, for instance. -Holes. Perforations or openings that allow the repurposer to insert or pass things through them. -Contours/edges. Guidelines or patterns that could indicate the repurposer many possibilities, such as cutting, peeling, etc. -Flanges. Flanges act as resting surfaces, as limits or attachments for other objects, and as structure strengtheners. -Panels. Usually they refer to rectangular surfaces in an object. The repurposer can use them as raw material.
✔	Avoid sharp edges. Sharp edges mean that a subsequent craftsperson or repurposer will have to be very careful. This can inhibit or intimidate repurposing. Sharp edges should be avoided as much as possible.
✔	Not hazardous. Products designed for repurposing have to be safe, for instance, from toxicity. If perilous at any level, explanatory labels should be provided so that components could be easily removed.

Products won't necessarily meet all these criteria, but I encourage designers to consider the potential of most of them. As stated earlier in the previous chapter, my goal with these criteria is to encourage designers, engineers and manufacturers to design for repurposing.

Copies of these checklists can be found in Appendix I.

Design for Repurposing Categories

As a result of the artifact study and the design for repurposing checklists, I have come to the conclusion that products designed for repurposing generally share the central attribute of *extended longevity*. In all cases, repurposing increases longevity. Products are designed to have a second life or incarnation in order to extend their lifespan.

St. Pierre, in the article “Here Today, Here Tomorrow: Design Strategies to Lengthen Product Life Span” states her concern about the amount of waste generated by products have short life spans. “At a fundamental level, the way that we think when we are designing a product when we know it will be out of date in a year is radically different from how we would be able to think of it if we believed it might be handled with care and respect over generations” (1). While St. Pierre is referring to how we think when we design for a long product first life, I believe that the designer's creative thoughts can also turn to seeding the ground for future repurposing. Designers can imagine repurposing potential in the early stages of the design.

However not all objects have the same characteristics or are repurposed in the same way. There are three major ways of approaching design for repurposing.

Planned repurposing. The designer has most likely planned the second life of the product with some probability of success. The purposes of some products are already determined. In the context of repurposing, Fruits and Passion, a Canadian based boutique, has planned the second life of some of its products’ packaging. Eau de Toilette 50ml comes in a packaging that transforms into a reusable bag (“Eau de Toilette”).

As well, the Nutella Jar previously described in chapter three, is another good example of a product that appears to have been designed for repurposing with a planned and obvious application: a drinking glass.

Coached repurposing/suggestions. While designers can't predict what products will be used for or transformed into, they can make suggestions that may or may not be acted upon. Labels and tags could be included in the product, suggesting how to transform it beyond its first life. Juice containers, made of cardboard and aluminum could display instructions or suggestions of how to turn the package into a coin purse, for example. This category is the exception of the second checklist's (individual scale) guidelines, where I suggest the object to be as easy ad obvious as possible.

Open-Ended repurposing. Here the designer acknowledges that the repurposers will do what they wish when they repurpose the product, and simply details the final components according to the repurposing guidelines, to allow for the greatest flexibility. Open-ended repurposing means that objects are not restrained by definite limits. They can be turn into yet to be imagined things. Objects are adaptable to changes, so the user can take over and decide what to do with them. In the context of open-ended repurposing, the rim grill described in the Mexico research chapter, is a good example. Instead of being transformed into a grill, the truck's wheel rim could have been transformed into a chair (another of Mr. Blanco's creations).

The following is the second of my degree completion requirements (thesis essay + visual component). These panels and the messenger bag were exhibited on May first, 2010, at the Charles Scott Gallery, at Emily Carr University of Art + Design. I designed these items following some of the guidelines in my checklists. See appendix II for both panels and messenger bag in detail.

Fig. 14 Aguirre, Darinka. Design for Repurposing exhibition panels. May 1st, 2010.

In terms of affordances, the panels are made of vinyl, a long lasting and flexible material; and have symmetrical notches, and grommets, which can be used to roll them, tie and strap them. I also included a pattern to make a messenger bag. While the inclusion of this pattern falls into the category of coached repurposing, I would like to draw your attention to how the details and material quality support open-ended repurposing, where the product can be transformed into anything. Some of the sketches in panel three display some repurposing ideas.

Anne Thorpe discusses open design processes “the most important aspect of an open process may be that objects that produce better fit, […] or appropriation […] replace some of the commercially driven meanings we have now” (146). In the previous example, Mr. Blanco appropriated this artifact by spending time working and customizing it. Therefore, open design processes create meaning. “To avoid […] obsolescence, products must mutually evolve alongside users, sustaining value by revealing their true beauty only through the slow passing of time” (Chapman 47). I believe that repurposing is a process of engagement.

When it comes to repurposing itself, there are some qualities that are worth exploring. These approaches are determined by the repurposer, not by the designer:

- *Utilitarian priority.* Because function is a critical element for most objects, many repurposed objects fulfill needs, not trends. Usefulness is preferable to beauty or ornamentation. The more utility that can be offered to the repurposer, the better, such as how a shopping cart (a frequently repurposed product) offers the capacity to carry, store and move articles.
- *Ornamental repurposing.* Some objects will be repurposed to fulfill an ornamental function. For instance, the interior components of a computer could be turn into jewelry. Empty CD cases could be used as a canvas for paintings, or, they could be converted into picture frames. The possibility of a product becoming decoration is always there.

Repurposing and complexity

Although design for repurposing aims to make repurposing as easy as possible to repurposers, complexity, time and effort will vary, and are important considerations. There are products that are more complex than others in their design, so the time and effort spent while repurposing is considerably more complex. For instance, disassembling and repurposing a car can be more complicated and time consuming than that of a toaster. The former is bigger, heavier and has more components -made of many different materials- than the latter.

The following list classifies repurposing in relation to its complexity.

- *Obvious*. The repurposer identifies the object or its parts and uses them as they are. Artifact B. Washing machine drum and the Nutella jar examples fit into this classification. Both objects are vessels. It is obvious to use them as receptacles. Few if any transformations are needed.
- *Easy*. Like obvious repurposing, the user identifies components that can be taken advantage of. However, this task may require making some slight effort. In a microwave, some of its panels can be used as serving trays, as shelving units, etc. In order to achieve this, the user has to disassemble the microwave first by using basic tools such as pliers, hammers, and screwdrivers.
- *Medium complexity.* This level of repurposing requires some physical transformations, such as cutting, punching, weaving and folding. For instance, an oil drum transformed into a fence, requires cutting it vertically, removing both lids, and pounding the drum with a hammer until it becomes a flat surface.
- *High complexity.* An object that has numerous or complex components make it necessary to produce new parts to accomplish what the user envisions. Artifact A. Sink-grill fits into this category. It is necessary to make and weld an iron structure onto it. Additionally, a cooking grid that fits the size of the sink is required. The user has to have a certain level of expertise, skills and tools to achieve the transformation.

Good Design for Repurposing

Well-designed products respond to troubled times. The market is flooded with a wide array of products of varying quality. Many of these products are highly effective, but a significant number fail to meet the expectations of consumers or satisfy the needs of industries and companies. In the context of a world where resources are so scarce, products should meet certain criteria in order to be good. Since one of this paper's goals is to demonstrate why repurposing is a good design strategy, it is important to redefine good design. In the following paragraphs, I discuss what good design is according to Dieter Rams, Donald Norman and Victor Papanek. For the purposes of *good design for repurposing*, I build on these ideas and sometimes I challenge them.

Good design is usually a combination of different attributes, what something does, what something looks like, and so on. Nevertheless as our design expectations of the world around us change, so do those attributes of design and the relationships between them.

Dieter Rams is one of the most influential industrial designers of the 20th century. He served as head of design at Braun for 30 years. Rams' is known for developing austere, user friendly, anti-stylish and anti-waste products. He speaks against throwaway society and recognizes the importance of designing products to last longer, by, gradually improving them over years ("Dieter Rams").

Rams named ten principles (or commandments) for what he considered as for good design.

Good design is innovative. "The possibilities for innovation are not, by any means, exhausted. […] But innovative design always develops in tandem with innovative technology, and can never be an end in itself" ("Dieter Rams"). *Good design for repurposing*

is innovative by introducing a new way to design objects: embedding products with the possibility of a second life beyond the first one.

Good design makes a product useful. “A product is bought to be used. It has to satisfy certain criteria, not only functional, but also psychological and aesthetic” (“Dieter Rams”). In contrast, Papanek states, “All objects, tools, graphics and dwellings must work towards the needs of the end-user on a more basic level than mere appearance” (235). *Good design for repurposing* extends usefulness of product beyond its first life of service.

Good design is aesthetic. “The aesthetic quality of a product is integral to its usefulness because products we use every day affect our person and our well-being. But only well-executed objects can be beautiful” (“Dieter Rams”). For Papanek, “if it functions, it is beautiful” (49). For *good design for repurposing*, aesthetics are unpredictable, because the designer does not usually determine the subsequent transformation. However, good detailing as indicated in the repurposing checklist, carries its own aesthetic value, and that remains in the control of the designer.

Good design makes a product understandable. “It clarifies the product’s structure. […] At best, it is self-explanatory” (“Dieter Rams”). Papanek addresses that complex or over- designed objects are overwhelming and intimidate the user (49). Norman cites two examples. “Frequent travelers have come to detest (in other words, hate) the alarm clocks provided by most hotels. I just stayed at a fancy […] *Hotel* and was driven to distraction by the idiotic Nakamichi alarm clock. Oh yes, it was very attractive. It even had a built-in CD player. Problem is, I could never figure it out, and I like to think I am pretty good at these things. Even though it had printed instructions, in my week at that hotel I never mastered the clock, not even once.” The second example has little to do with good design. “Robbers foiled because they couldn't open the doors into the restaurant they planned to rob. They

pushed, pulled, and kicked), but they were sliding doors. Yes, there was a sign, but as you all know, if it needs a sign, it's badly designed" (Norman, "In Praise"). *Good design for repurposing* speaks through affordances, which reveal themselves. Generally, few if no explanations are needed. There are no instructions; only clues and cues for the repurposer to be inspired by.

Good design is unobtrusive. "Products fulfilling a purpose are like tools. They are neither decorative objects nor works of art. Their design should therefore be both neutral and restrained, to leave room for the user's self-expression" ("Dieter Rams"). *Good design for repurposing* invites the user to play, to be creative, to appropriate artifacts and to customize them.

Good design is honest. "It does not make a product more innovative, powerful or valuable than it really is. It does not attempt to manipulate the consumer with promises that cannot be kept" ("Dieter Rams"). *Good design for repurposing* is honest to its purpose: to invite repurposing.

Good design is long- lasting. "It avoids being fashionable and therefore never appears antiquated. Unlike fashionable design, it lasts many years – even in today's throwaway society" ("Dieter Rams"). Papanek states, "In a world that is running out of energy and has its back to the wall ecologically and environmentally, we must build and design for the long haul"(56). *Good design for repurposing* is long- lasting. It does not follow trends. However it could relate to cultural shifting through them. It extends products longevity through features like materials and function, and through the action of repurposing –the repurposer will transform it into the object that will be needed in the future.

Good design is consequent to the last detail. "Nothing must be arbitrary or left to chance. Care and accuracy in the design process show respect towards the consumer"

(“Dieter Rams”). *Good design for repurposing* places great emphasis on the value of details. Details represent opportunities for the user’s imagination. However, good design for repurposing is open to chance and choice. The details are provided, but the consumer will do the interpretation. For instance, we could detail for repurposing in the design of a TV, but we cannot anticipate how those features will be used for. In Mexico, TV carcasses are used in farms as chickens’ nests.

Good design is environmentally friendly. “Design makes an important contribution to the preservation of the environment. It conserves resources and minimizes physical and visual pollution throughout the lifecycle of the product” (“Dieter Rams”). *Good design for repurposing* helps avoid waste. Products are designed for disassembly first so their components can be separated and recycled or reused. *Good design for repurposing* extends the life of products by fostering their transformation into another useful object. This way, the number of products that end up in landfills and their environmental impact are reduced.

Good design is as little design as possible. “Less, but better – because it concentrates on the essential aspects, and the products are not burdened with non-essentials” (“Dieter Rams”). However, *good design for repurposing* takes less even further. The repurposed object needs very little added to it in the way of materials.

Therefore, *good design for repurposing:*

- Is innovative by introducing a new way to design objects: products with a second, third or even more incarnations.
- Extends functionality.
- Speaks through affordances, which reveal themselves.

- Invites the user to play, to be creative, to appropriate artifacts and to customize them.
- Is honest to its purpose.
- Does not follow trends.
- Looks at details in greater depth.
- Is good for the environment. It avoids waste by extending the life of products by transforming them into another useful object.

It is evident that these criteria for good design for repurposing do not set a simple standard for quantitatively or qualitatively measuring the value of every product. Rather, they should help guide product design during its first stages. The real challenge in seeking good design for repurposing is to evaluate each design opportunity individually, while striving to improve existing attributes so the object will have more possibilities for repurposing in the future.

Conclusion

In this thesis I have attempted, through various perspectives and explorations, to offer an understanding of why objects should be designed with a second life in mind. I have detailed the benefits of this strategy and I have provided simple guidelines for designers and engineers who wish to design for repurposing. I have also discussed the creative and positive contribution of design for repurposing. I hope that the discussions and examples presented here will inspire and provide the reader with an informative and stimulating set of ideas from which to consider the importance of designing for repurposing instead of allowing obsolescence.

Imagine a world where design for repurposing has become standard practice. Take, as a fictional example, Peter, a resident of Vancouver, Canada. He is visiting the new Repurposing station (subsidized by the government) located in Richmond. He just read that it gathers landfill-bound materials and objects from local business and industry (who pay a collection fee) and makes them available to other individuals, such as companies, entrepreneurs, teachers, students, parents, and other groups, at no cost. Also, every weekend it offers repurposing workshops for adults and children at $5 dollars per class. Material of course is supplied for free. After walking around for a while, Peter comes up with a clever way to transform old springs from trucks into stools. These are not common springs and Peter acknowledges this. They have been part of a truck that clearly displays the *designed for repurposing* seal. These springs have special features: they are not sharp and they have a cylindrical profile and rounded ends. He develops expertise working with these springs, and he starts a business selling his stools to bars and restaurants. The business becomes successful and he hires workers to help him in his business. He has to order truckloads of them (which come from a repurposing station) in bulk (at minimal cost) to satisfy the demand.

During the repurposing process, it is detected that some of the springs have sections that have been damaged during their previous life. Thus, the damaged springs have to be cut in order to repurpose the good sections of them, while the damaged sections are sent back to the repurposing station. It is likely that someone else may find a new use for these. The repurposing of springs has become a success. Peter has also developed a new line of stools for children. From one single spring he gets two children's stools. This process involves cutting the springs in half to be shorter for a child's scale. The stools become popular at birthday parties. The result of refining and adapting the design is that even more potential waste from discarded springs is avoided.

In the old cradle-to-grave model, these springs would have been thrown away, or hopefully would have been recycled, which would have involved consumption of energy. But through Design for Repurposing, valuable materials and energy are saved, and Peter is making money and expanding his business.

In this scenario we have two businesses—the repurposing station which makes money from the shipping fees that charges companies and industry to pick up discarded material and objects, and from the workshops it holds every weekend; and Peter's small business—but no waste, because the waste was turned into a resource.

Multiply these scenarios thousands of times and we can see how design for repurposing can unleash the creative power of people, create jobs and opportunities, and help the environment. Design for repurposing can give repurposers/entrepreneurs free rein to turn the "waste" into something of value, because when anything that is unwanted and discarded gets reused or repurposed, it immediately reenters the global economy with practically no energy expenditure at all. It doesn't need to sit around for a million years turning to rust or topsoil; it doesn't need to be shipped to China and melted down and recast

as ingots and then shipped to a factory and turned into a low-quality copy of whatever it was during its first life. Without having to travel anywhere, or use enormous amounts of energy, the object once again becomes useful to humankind, without the time and investment of a great deal of processing. I believe design for repurposing deserves to be recognized alongside existing strategies as a way to address our current environmental problems.

To conclude, I point out the three main benefits of design for repurposing for people and the environment:

- *It can be less resource intensive and expensive than thermal recycling.* Repurposing costs less. Is a straightforward manipulation of materials, it is less process-intensive than recycling.
- *It preserves natural resources for future generations.* Repurposing reduces the need for raw materials, therefore conserves natural resources for the future.
- *It creates employment opportunities.* Repurposing invites people to become entrepreneurs. They can sell their creations, trade components, set their own shops/ businesses, and refurbish and repair other peoples' objects.

"What can change are the products themselves –how they are made, what they are made of and what happens to them once their immediate usefulness has expired" (Shreve 15).

I strongly believe that Design for Repurposing will become more important as our understanding of sustainability and the environment continues to grow.

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Appendix I.

	Design for Repurposing Checklist (Batch Production) ***Steps to get started***
	Designed for disassembly. This is a core value. For comprehensive information please refer to the guidelines in the chapter on design for disassembly. A checklist reference on design for disassembly is in appendix I. In brief, most of the components can be separated through simple processes/tools. If there are parts that won't be used in the repurposing process, they are suitable for recycling or reuse. These components are identified either by color, display tag or label.
	Durable materials. In products designed for repurposing, materials and components are durable and capable of functioning well in another role. It is ideal that materials are long lasting. For example, stainless steel is ideal because it is rust resistant.
	Affordances. The designer provides cues and clues. Some of them are: -Symmetry. If a shape is symmetrical, it can be divided into two equal parts. It also means repetition in sub elements, like the pattern of veins in wood, for instance. -Holes. Perforations or openings that allow to insert or pass things through them. -Contours/edges. Guidelines or patterns that could indicate possibilities, such as cutting, peeling, etc. -Flanges. Flanges act as resting surfaces, as limits or attachments for other objects, and as structure strengtheners. -Panels. Usually they refer to rectangular surfaces in an object. They can be used as raw material.
	Sharp edges. Sharp edges are design, situation or context dependant. In some cases they might be desirable, in some others they won't.
	Not hazardous. Products designed for repurposing strive to be safe, for instance, from toxicity. If perilous at any level, explanatory labels should be provided so that components could be easily removed.

	Design for Repurposing Checklist (DIY: Do It Yourself) ***Steps to get started***
	Designed for disassembly. This is a core value. For comprehensive information please refer to the guidelines in the chapter on design for disassembly. A checklist reference on design for disassembly is in appendix I. In brief, most of the components can be separated effortlessly and safely through simple tools, such as screwdrivers, pliers, hammers, etc. If there are parts that won't be used in the repurposing process, they are suitable for recycling or reuse. These components are identified either by color, display tag or label so the repurposer identifies them easily.
	Durable materials. In products designed for repurposing, materials and components are durable and capable of functioning well in another role. It is ideal that materials are long lasting. For example, stainless steel is ideal because it is rust resistant.
	Immediate functionality. Consider the possibility that some of the dismantled components might offer immediate functionality, such as containers, vessels, strainers, etc. Strive to retain that potential in the newly configured design.
	Inviting. The product invites the repurposer to transform it. Its engagement is partly informed by its material quality. It might also be appealing via its formal qualities.
	Easy and obvious. No explanations, if any are needed. The simpler, the better.
	Affordances. The designer provides cues and clues for the repurposer. Generally, affordances reveal themselves. Some of them are: -Symmetry. If a shape is symmetrical, it can be divided into two equal parts. It also means repetition in sub elements, like the pattern of veins in wood, for instance. -Holes. Perforations or openings that allow the repurposer to insert or pass things through them. -Contours/edges. Guidelines or patterns that could indicate the repurposer many possibilities, such as cutting, peeling, etc. -Flanges. Flanges act as resting surfaces, as limits or attachments for other objects, and as structure strengtheners. -Panels. Usually they refer to rectangular surfaces in an object. The repurposer can use them as raw material.
	Avoid sharp edges. Sharp edges mean that a subsequent craftsperson or repurposer will have to be very careful. This can inhibit or intimidate repurposing. Sharp edges should be avoided as much as possible.
	Not hazardous. Products designed for repurposing have to be safe, for instance, from toxicity. If perilous at any level, explanatory labels should be provided so that components could be easily removed.

Appendix II.

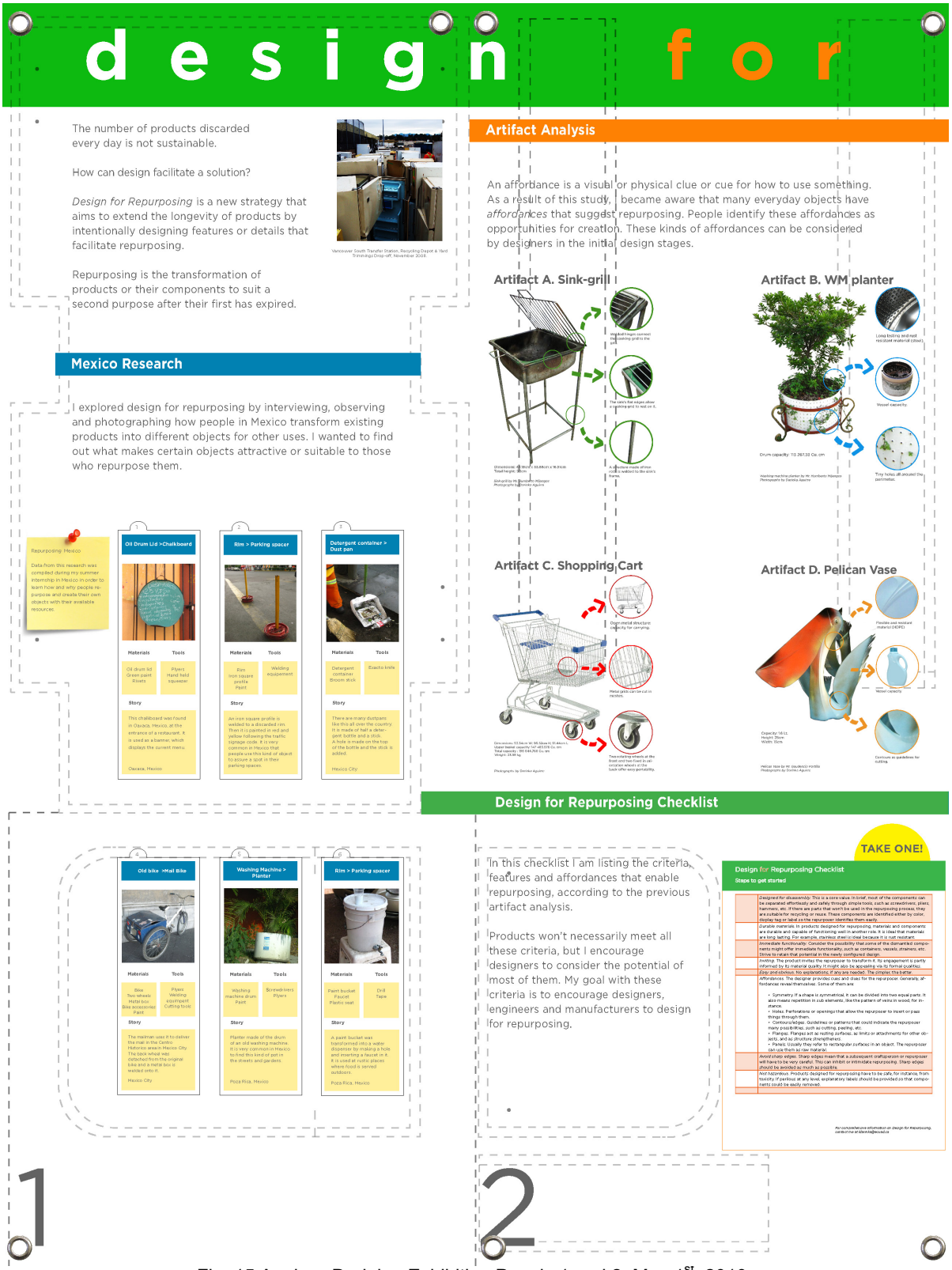

Fig. 15 Aguirre, Darinka. Exhibition Panels 1 and 2. May 1st, 2010.

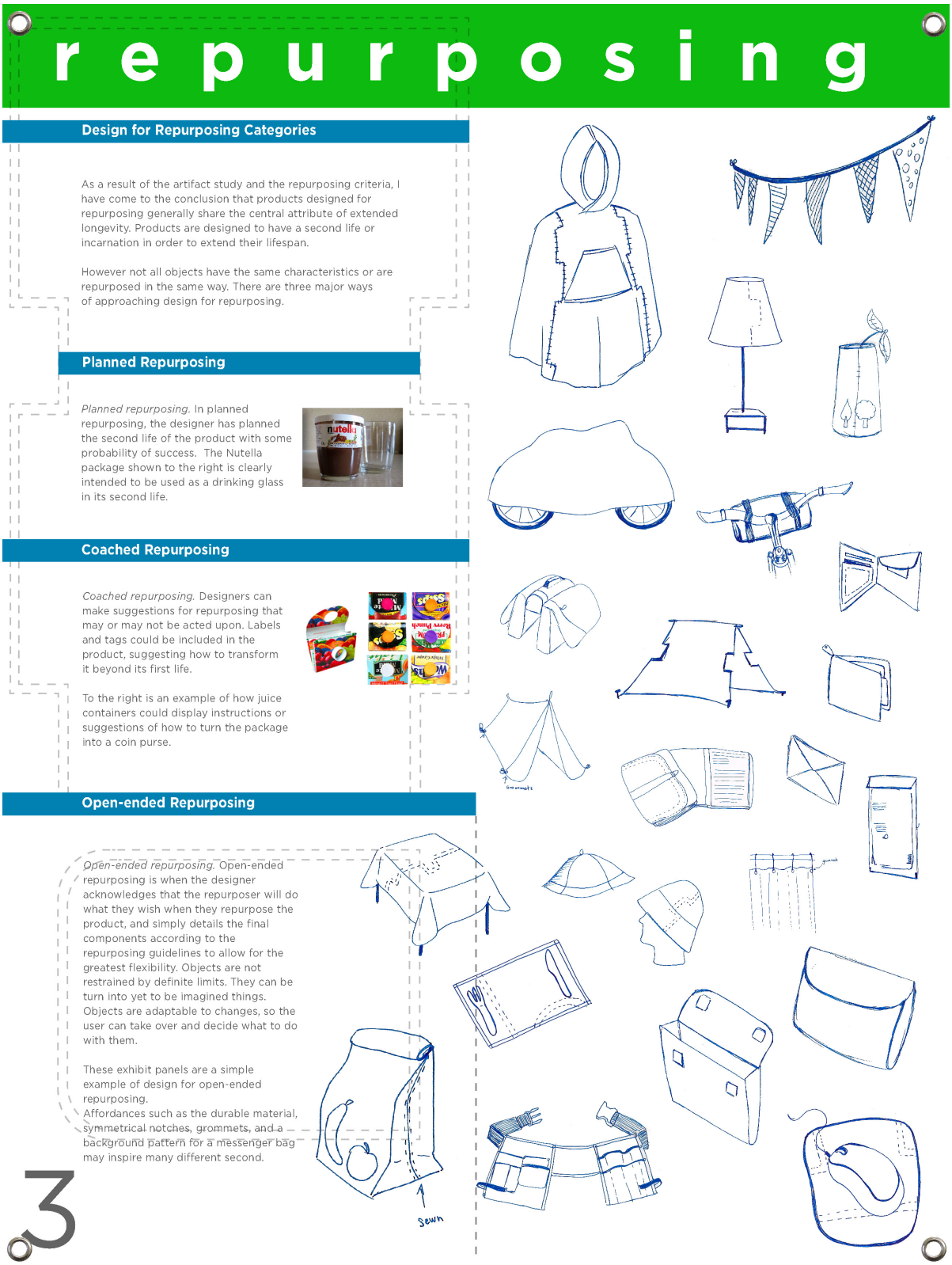

Fig. 16 Aguirre, Darinka. Exhibition Panel 3. May 1st, 2010.

Fig. 17 Aguirre, Darinka. Messenger Bag. May 1st, 2010.