How Design relates to Waste:
A Categorization of Concrete Examples

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Background

Waste generation grows faster than the population due to increased consumption (Baker et al. 2004). Simultaneously, the availability of resources and the ability of ecosystems to provide them are decreasing (Holmberg 1998). Keeping materials in continuous loops gains importance (McDonough & Braungart 2002; El-Haggar 2007; Foundation 2012), not only as sustainable waste management (WM), but as a way to provide the materials future generations will require.

Aim and Method

In order to explore the existing relation between WM and Design, an interview study was carried out in 2011, targeting designers who have worked with waste (11) and WM professionals (14). The interviewees originated from Sweden (13), Germany (five), Egypt (one), India (one) and Chile (five) to provide cultural diversity to the study.

The interviews were semi-structured in character following an interview guide. The interviewees were introduced to the objectives of the study and the definitions used in the guide. They were asked if they considered design to have any relation to WM. As a trigger, the interviewees were later shown two visual cards with examples of products that relate design and waste. They where asked to comment on these and name projects which according to their knowledge were good examples of how WM and design relate.

Outcome

During the interviews 74 examples came up in an unstructured way. This article categorizes the examples obtained in the study into five relevant groups, which are explained and exemplified with a selection of their best cases: I. Material Recycling; II. New Materials from Waste; III. Redistribution; IV. New Products from Waste; V. Design for End-of-Life.

I Material Recycling

The examples in this category refer to industrial re-manufacturing of material into similar products, maintaining their qualities. The recycling industries mentioned were: **Paper**, **Glass**, **Aluminum**, **Metal**, **PET** and **Plastic**. This makes the sorting of these materials a profitable endeavor.

It is interesting to notice that aluminum was mentioned separately from metals in general, as was PET from recycled plastics. Even though plastic recycling (without specifying what polymer) was not considered an important industry, the use of recycled plastic was mentioned as input material for small products, garden furniture, etc.

Recycling varies between developed and developing countries. The first rely on formal recycling centers where everybody is expected to separate their waste into different fractions. In developing countries however informal recycling is done by people of low income, as means of improving their economical situation.

II New Materials from Waste

Other examples pointed out the development of new raw materials from waste. These materials, usually composites, aim to be sold in the material market, so they can be used for products that serve a different function, benefiting from it's new properties. The cases that best clarify this are:

1. Polyplank

Polyplank is recovered thermoplastics mixed with wood fiber (wood mill by-product) that generate a composite that can be string or injection molded. It does not require surface treatment and can be processed like a normal wood plank (Polyplank 2012). It can be recycled by the same producers between 4 to 7 times before they need to add more Polyplank composite. For final disposition the material's energy can be extracted through combustion.

2. Tectan

In an effort to make their material more recyclable,Tetra-pack launched the Tectan board in 1991. Made only of reused tetra-pack that were grounded, laid into sheets and binded with heat and pressure. The polyethylene fraction of the original packagings acts as adhesive, requiring no extra material. The boards composition is the same as the original tetra-pack material: 75% paper, 20% polyethylene and 5% aluminum, resulting in a material with good insulation properties, water resistant, noise absorbing, thermoformable and recyclable (El-Haggar 2007).

Despite this apparent success, tectan boards have not proliferated and Tetra-pack now promotes paper mill recycling of their products (TetraPak 2012). The company that developed the original board continues to make tectan products for industrial applications out of packaging production waste.

3. Waste Incineration Ash

Some MSW systems incinerate the waste that is not separated for recycling. This allows them to extract energy (in form of heat and sometimes electricity) from the waste. After the process the waste is reduced to ashes, that occupy only 10% of it's original volume (El-Haggar 2007). Depending on the composition of the waste incinerated, left over ash could be considered harmless inert material from which land reclamation, bricks, tiles and pavement can be produced. Another common use for this ash is as landfill covering material.

III Redistribution

Other examples from the interviews were non-disposal systems that provide alternative routes for specific waste streams, mainly through repair and/or relocation.

1. Second-Hand markets

Mainly focused on clothes, furniture and household appliances, second hand markets provide a valid alternative for products that are still in conditions to be used. They can be formal and established (e.g. Myrorna in Gothenburg) or informal (e.g. flee markets, Blocket 2012), where anybody can sell items. The quality of the items found in second-hand stores was regarded as acceptable or good by the interviewees from EU countries, where as it was frequently seen as not acceptable in non-EU interviews.

2. Charity Organizations

Many organizations operate doing material relief for people in need around the world, relocating donated goods. E.g. Human Bridge Charity, a Swedish NGO collects, sorts, packs and ships clothes and reconditioned hospital equipment to development organizations (Human Bridge 2012).

3. Hacking and DIY movements

One interviewee suggested that hacking[1] helps people find alternative uses for things they have instead of discarding them. Sites like (Hack-a-Day 2012) provide useful information. The same is true for DIY initiatives, that openly show how to re-purpose things. Crabbe 2012 says that the DIY movement aims to help people reduce their consumption rather than generate new products for the market, so these efforts can be seen as waste prevention.

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1 Heavily modifying software or hardware of their own computer or anything else, either to make it better or faster or to give it added features or to make it do something it was never intended to do.

4. WEEE

WEEE is a special case: Given it's toxic components it cannot be disposed with normal waste, so collection systems have been developed in many cities. It also contains a high yield of valuable material that make it interesting for recycling. What happens with WEEE varies greatly form one location to another:

i. To recuperate components and fix non functioning WEEE was considered a big activity in Pune and Cairo, mainly carried out by the informal sector. The prices for repairing electronic equipment are well under the costs for new equipment, due to the availability of cheap labor. When equipment can not be fixed it is dismantled and it's useful components separated for latter use. The rest is stripped of it's valuable metals for recycling. However, this brings health and environmental problems (Park 2010) and both governments struggle in attempts of formalizing this activity to include the informal workforce already skilled in this field (Fahmi & Sutton 2010; Pune Municipal Council 2006).

ii. Informal recycling of WEEE is done in Chile, but not as massively as in Cairo or Pune. Recycla Chile, was the first formal company in Latin America to recycle used computers. They offer WEEE recycling services to companies, charging for dismantling discarded equipment and assuring safe disposal of hazardous components. During this process they recuperate valuable materials and components for reuse or recycling. They use some functioning components to refurbish computers, used later in social programs (BusinessWeek 2009).

iii. In Europe repairing WEEE to be used locally was considered unprofitable. A Swedish interviewee recalled a project that refurbished computers to send them to countries in Africa as charity. This common practice in developed countries turns out to be problematic: Even though trading used electronic goods to developing countries is intended to help them use ICT, it poses a challenge of how to handle the E-waste that remains (Basel Convention 2011). This report states: “30% of the used EEE imported was non-functioning (e-waste): half of this amount was repaired locally and sold to consumers and the other half was not repairable.” It is also unclear how long the repaired EEE works after it is sold, generating something called “near-end-of-life” equipment, which can be considered a big source of E-waste in West African countries.

IV New products from Waste

Commonly referred to as Up-cycling, this category is the one that generated most examples. It consists of re-manufacturing waste by means of product design, converting wasted resources into ready to use products.

1. WEEE Jewelry.

This type of handcraft will probably not tackle the escalating WEEE problem, but it gives an alternative. It is a recurrent phenomenon with several jeweler entrepreneurs offering their recycled creations at stores, fairs and web-pages. Results vary widely in style and quality. E.g.: (Arteco 2012; Etsy 2012) Figure 1 shows WEEE cuff-links, by David Wright.

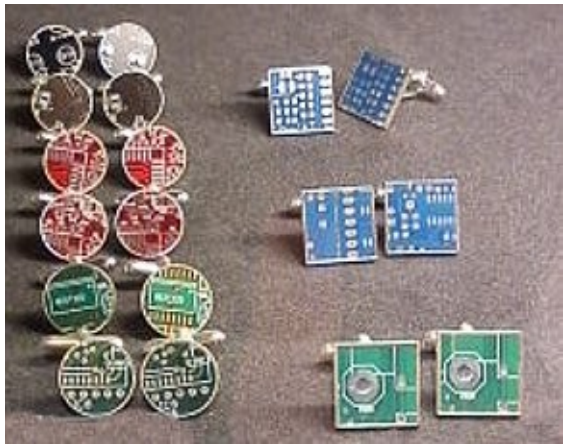

Figure 1

2. Bags made from recycled material.

Also a recurrent item, done by entrepreneurs as well as bigger companies. It varies widely in quality and style. Interviewees considered it both good and bad examples, depending mainly on the final product's quality. Examples made out of single materials are often better finished. Some examples that use woven food wrappings achieve a nice final product, but other simply do not. TerraCycle 2012 offers both kind.

A good example is Retape 2012. The designer Lucrecia Lovera makes products out of woven used magnetic tape. This won her the ModaFAD prize for best male collection in 2008. She says the idea came up testing different materials to work with. Between other properties it was stable, strong, durable, lightweight and, of course, eye-catching. Figure 2: Partyparty, by Retape.

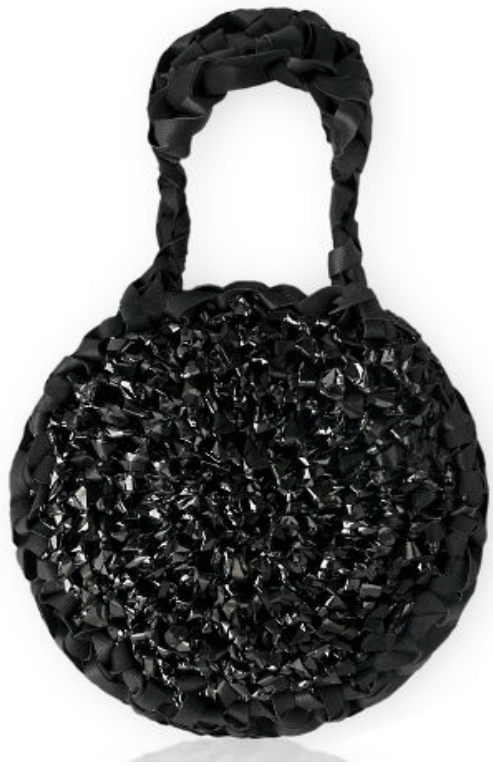

Figure 2

Demano, from Barcelona is another good example. They use discarded cultural events banners. Fig 3: Marbella bag, by DeMano 2012.

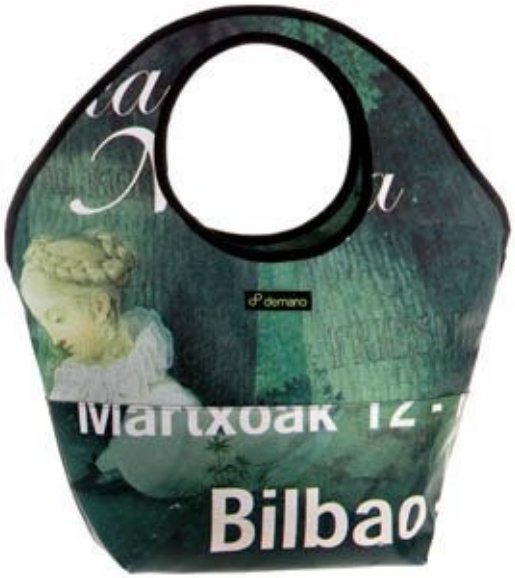

Figure 3

3. Showraum

This group produces handmade furniture and product design from used and found material. The self denominated “Kreuzberg (Berlin) based resource for hand made design”, display ready made products and receive orders for custom made furniture for their “growing network of international designers”. They aim for special things that are unique and well made. Figure 4: CMYX, by Kerti. Image from ShowRaum 2012.

4. Reline tableware

This set of tableware was made by collecting pieces of white pottery, that no longer had all the pieces to make a set. To give them a visual unity, the designer ties the group with a flashy pink line. Figure 5: Reline, by Anna Bormann. Image from Bormann 2012.

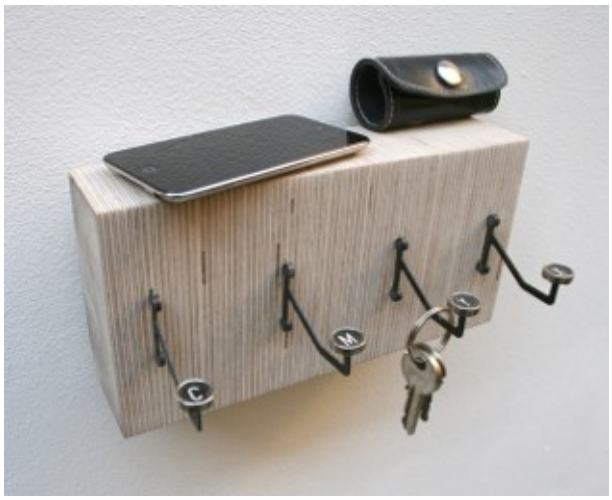

Figure 4

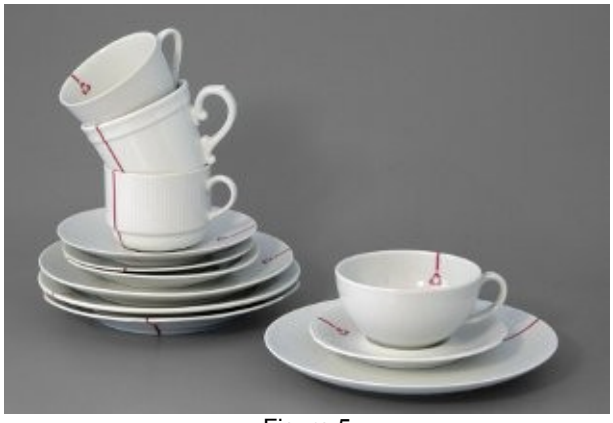

Figure 5

5. SchubLaden

This workshop-store refurbishes old drawers incorporating them into new bureaus. The drawers are collected, treated and combined to give each piece of furniture a part from another time. The designers aim to give high quality long lasting furniture, with a piece of history that makes it unique. Figure 6: Möbel 37|08. Image by Nina Straßgütl, SchubLaden 2012.

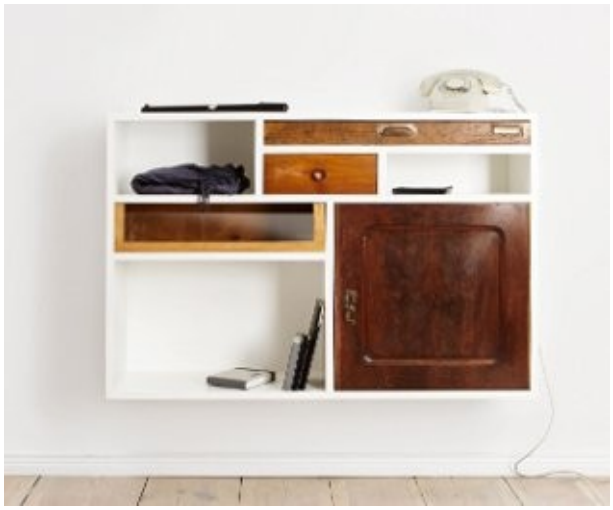

Figure 6

6. Remade in Chile

With a yearly design contest, this non profit organization aims to promote recycling, reuse and environmental care with design in Chile. It has collected many good examples over the years, worth looking into. Figure 7: Implum, by Genoveva Cifuentes. Image from Remade in Chile 2012. This 2011 winner made biodegradable products for plants made out of agglomerated plum seeds.

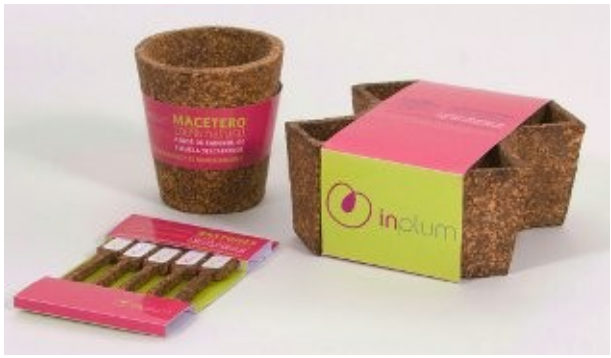

Figure 7

7. Creatables

This young Swedish design company develops products using scrap material from different industries. Sometimes they fit their die-cut design into the same production process from the “hosting industry”. They call this “production hacking”, which has the advantage of requiring no extra energy to make their product (Creatables 2012).

8. Taller Re-Crear

Espora did workshops under a project of the foundation “Casa de la Paz” in Chile, aiming to teach informal recyclers from the municipality of Peñalolén how to work discarded materials in order to generate more value by their occupation. PET recycling in Chile gives little or no profit to informal recyclers. However, products from PET can be directly sold to interested public generating a better revenue. That is why this broadly discarded material was chosen as base for “Re-Crear” workshop. Figure 8: Pencil-holder “Cala”, by Espora, Diseño Conciente 2012.

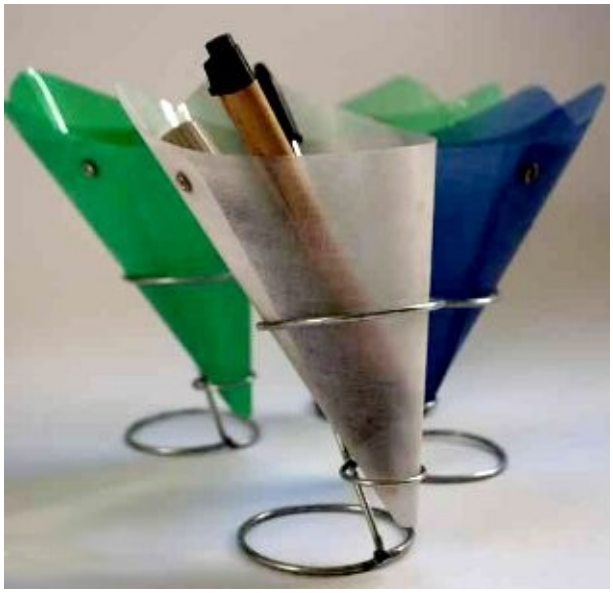

Figure 8

Figures 9 -11 are some of many examples omitted due to space limitations.

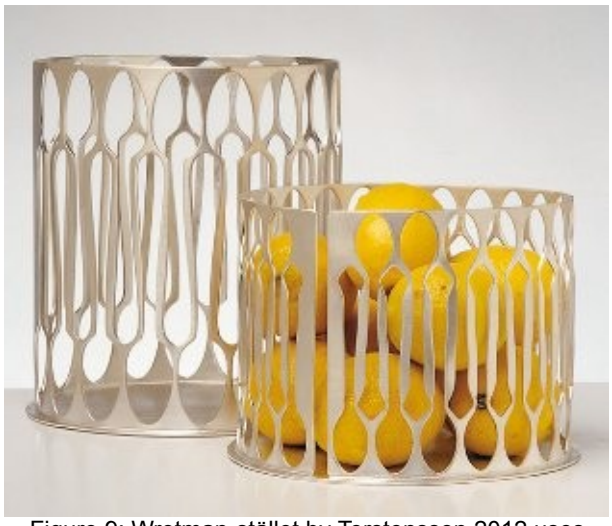

Figure 9: Wretman-stället by Torstensson 2012 uses leftovers from silverware production.

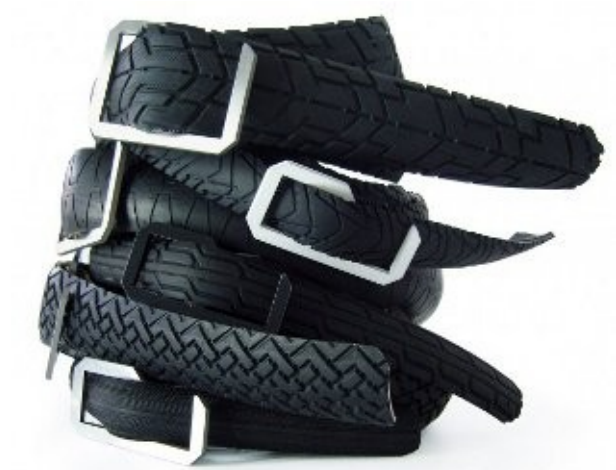

Figure 10: Profil belts by Yeayea 2012, out of bike tires.

Figure 11:N+ew, by Alonso 2012. Seat-installation of encapsulated WEEE.

V Design for End-of-life

This category groups products that have been developed considering their end-of-life stage, in parallel to other product requirements. Planning for the end-of-life can avoid disposal all together, or even turn used materials into something beneficial.

1. Glass containers for ketchup or mustard used as glasses.

Different food is sold in glass containers, but some companies (e.g. Maille, Bautzner Senf, Amora, etc) make efforts to have their packing be used as drinking glasses afterwards. These drinking-glass-shaped jars are sold with a removable plastic lid to distribute the product. This was regarded by the interviewees as a good practice in packaging. Although one interviewee did consider it sometimes falls to the excess, giving as example seasonal products that are sold in very elaborated ceramic vessels.

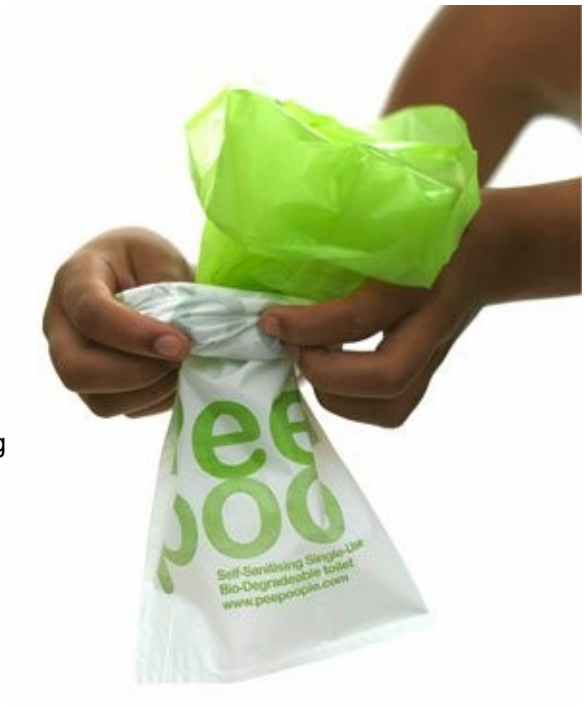

Figure 12

2. PeePoo

Peepoo is a biodegradable plastic bag that one can use as a toilet. It has an extensible inner lining that facilitates this action (Figure 12, image from Peepoople / Niklas Palmklint / Peepoo studio photo). It is intended as a sustainable sanitary solution for slum areas and refugee camps. It converts the common use of the “flying toilet” (feces in a regular plastic bag, latter thrown out the window) to a more sustainable practice. The difference is that, besides being biodegradable, Peepoo has an inner coating of urea (non hazardous common fertilizer). When the urea comes in contact with feces or urine it generates a chemical reaction that kills the bacteria and parasites that normally occur within a couple of weeks. This means that when Peepoo degrades into the soil it becomes a harmless fertilizer rich in nutrients (Peepoople 2012).

3. Janipad

This product is a biodegradable sanitary pad made out of paper produced with water hyacinth. The project was developed during a course in Kenya by students from Chalmers University (Sweden). Water hyacinth is a problem in Lake Victoria, so the students develop a biodegradable solution with it (JaniPad 2012).

4. ReturDesign, furniture made out of cardboard.

This is a design studio, located in Stockholm, that does furniture with cardboard. They use new heavy duty cardboard to create diverse type of stable furniture. To provide with easy recycling of their furniture the pieces have no treated surfaces and can be mounted and dismantled by the user. A clear example of design for recycling. Figure 13: Big Chaos shelf, by ReturDesign 2012.

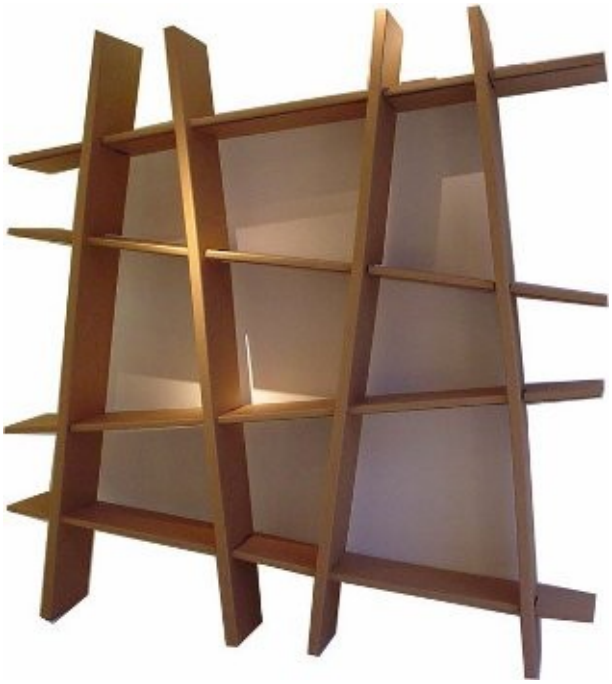

Figure 13

Conclusions

Besides serving as a reference list for good examples of resource usage, the categorization clarifies barriers and strategies adopted in different cases of relating design with waste.

Material Recycling allows for processing large volumes of discards, making it very suitable for waste management as an alternative for disposal. However, many materials tend to down-cycle rather that recycle, loosing properties with every re-processing. Despite this, every new cycle the materials get, there is a saving of raw materials to perform that task. This is called cascading, and should be prioritized over disposal. Some materials recycle well (e.g. metals, glass) so the difficulty for having them in effective closed-loop systems lies in separating them correctly after their usage. This is why collaboration between design and waste management is crucial and strategies like Design for Disassembly or Design for Recycling are vitally important if we expect to recover most materials used.

Making **New Materials from Waste** broadens the possibilities that material recycling offers. It also allows for processing large volumes and by combining two or more materials a new material with enhanced properties can be obtained, which may prove to be more valuable. Much testing is required to obtain the desired properties, but the use of waste allows for cheap input material, which is a promising start for a profitable venture. How environmentally friendly this type of recycling is, however, can be widely debated. It still provides a promising alternative for material disposal.

These first two categories are of great importance given large volumes of discards they can handle. However, they only take advantage of waste as raw materials, eliminating their component or product properties. Instead, **redistributing** goods benefits from all these properties. Discarded products have to go through selection, sorting and maybe repair before being resold or redistributed. This is more work intensive than recycling and normally collects less revenue. It helps as an alternative to discarding useful products, but it is unclear if this reduces the need of new production. It also lacks improvement of products.

Up-cycling, or making **New Products from Waste** allows for product improvement while maintaining the properties of it's materials and some components. It allows for mixing the discarded elements with new materials, improving it's quality and performance. Even though this is an activity that is becoming common between designers, not that many are able to industrialize their production, falling into labor intensive handcraft. The main barrier to massify up-cycled designs is the irregularity of the components in the waste streams. To bridge this problem designers should select a material that has a constant flow and arrange to get access to that material on a regular basis.

However, up-cycling is still a palliative solution: we still generate waste. Ideally production should **Design for the End-of-life** of their products, by devising how to obtain the best possible value from their products once it's use stage is over and communicating it to the users. This avoids having to figure out how to handle the discards and provides an optimal, well thought of solution for that product to reintegrate to society, eliminating the concept of waste.

These final two categories take full advantage of discarded products and by use of design-thinking achieve the best results in closing the loop. Integrating end-of-life considerations to early design phases should be given priority if we ever expect to transform waste handling into resource management. These categories show how complementing design and waste management truly delivers better results.

Further work

Further research efforts are needed to see how we can reformulate the design process to serve as a tool for waste management. Using the gained categorization, we can strengthen the strategies used and include new ones to conquer the barriers found for linking waste with production.

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