Report

Reduce

"Globally feasible and viable product packaging solutions"

Research-Project

Summary of the research project and design courses, within the sustainability program of

MONASH University

Melbourne-Australia

Research and design studies by Master program student Eloïse Friberg, during exchange program 2022 from Royal Institute of Technology, Stockholm-Sweden.

Melbourne-Australia, November 2022

Foreword

Eloïse Friberg

Industrial engineering Master program student Eloïse Friberg at Royal Institute of Technology (KTH) Sweden, during exchange studies 2022 at Monash University Melbourne Australia, researched, investigated, reviewed, reported and propose available and feasible solutions and opportunities to Monash University and to the global packaging industry for faster and more efficient transformation to more sustainable, viable and recyclable packaging solutions, especially for all liquid and viscous products and contents.
Packaging material waste in our societies and lack or recycling, as well as use of common non-sustainable waste material landfills and/or industrial scale incineration plant processes, today are a massive, fast growing and severely damaging high-risk problems and pose challenges to all countries, governments and civilizations, environments, and nature, all over our entire planet on land in the seas.
Recent years gradually intensified attempts to investigate, understand, learn, and pinpoint the problems, has until today not demonstrated critically needed change and transformation progress towards more viable solutions. The question and debate whether the lack of progression is due to lack of technical solutions, lack of economic industry motivation and incentives or due to lack of legal/economic bonus /malus systems to stimulate change along the entire product lifecycle chain is ever debated around the planet and in media. In the meantime, the problem continues to grow globally hour by hour, day-by day, year-after-year in the gigantic high-volume massive constant process of global habits of fast consumable single use packaging materials that collectively and the way they lack recycling and viable handling, pose an explosive toxic recipe for today's and future generations.
This investigation documents and reports not only the severity and risks in the lack of progress in the transformation, but also that the needed solution already today is available,. Further, that the solution is viable, and that the solution will add values in the contribution towards more sustainable civilizations and welfare globally.
This project, investigative research and report from undersigned at Monash University, has been a valued and worthwhile, meaningful and stimulative project, as part of my studies towards my Master degree in Industrial Engineering at Monash University in Melbourne Australia and at the Royal Institute of Technology in Stockholm.
Now, with recently fully completed studies and examinations at Monash University, I am grateful for the valuable inputs, know-how and guidance from external expert sources. It is therefore also my grate honor and pleasure to especially dedicate this work and report to the key individual researcher, inventor, and developer Esa Mäkinen in Sweden, as well as to his associate partner the innovator, entrepreneur and pioneer Christofer Friberg, both numerously internationally awarded for their individual and combined limitless research, efforts, and mission to finally enable and bring viable solutions like EsaPac to global markets.

Monach University, Melbourne Australia December 2022.

Eloïse Friberg

Eloïse Friberg

IDE2120 – Designing for sustainability

Reduce project

Research

Materials and different packaging

Metal

- Made of iron or lead, which makes it non-renewable
- It's reusable and have a high durability
- Its expensive, heavy and can rust

Source: Storage containers, Advantages and disadvantages of metal storage containers, August 30, 2012, located the 4th of September: https://www.haulaway.com/blog/2012/08/advantages-and-disadvantages-of-metal-storage-containers/

Glass

- Made from natural and sustainably materials as sand, soda ash, limestone and recycled glass
- It can be endless recycled without lossing its properties
- Remain healthy and safe for food packaging regardless of recycled times

Source: The European container flass federation, *Why choose glass?,* located the 4th of September: https://feve.org/about-glass/

Plastic

- Made from fossil fuels, like oil, which make it non-renewable
- Majority of plastic is not recycled "Of all plastic ever created, 91% has not been recycled" – National Geographic
- It's strong, flexible, cheap to make and light weighted

Source: Matthew D, Plastic vs cardboard packaging: A complex choice, May 26 2020, located the 4th of september: https://theecobahn.com/packaging/plastic-vs-cardboard-packaging-a-complex-choice/

Paper

- Bio-based
- Most is recycled and can be reused
- Print directly on paper
- Poor barriers properties and if it end up in landfill it takes up much space

Source: SmartSolve, Pros and cons of paper packaging, November 23, 2021, located the 4th of September: https://www.smartsolve.com/news/paper-packaging-advantages-disadvantages

Cardboard

- Made from wood, making it renewable and one of the most sustainable materials
- Most is recycled
- Heavy in transportation, but easy to pack and stack

Source: Matthew D, *Plastic vs cardboard packaging: A complex choice*, May 26 2020, located the 4th of september: https://theecobahn.com/packaging/plastic-vs-cardboard-packaging-a-complex-choice/

Industries that over package

- Food
- Cosmetic
- Medical
- Clothing
- Tech industries
- Online shopping in general

Source: Pioneer packaging, *Why is over-packaging a problem?,* located the 4th of September: *https://pioneerphoenix.com/why-is-over-packaging-a-problem/*

Food packaging materials

Industry I want to tackle:

”Over 80% of food packaging examined in a new survey can’t go into home recycling bins”

- source: WWF Australia, located: here

Barriers that I want to address:

- Easier to recycle
- Reduce material use
- Use ecofriendly materials
- No spilled product

Sustainable packaging

1. Cornstarch

Used as plastic substitute:
- Bottles
- Loose-film

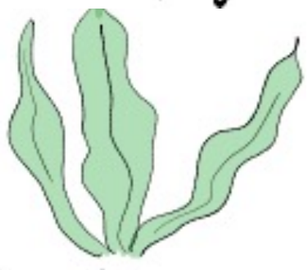
Ploblems:
- Competes with human and animal food
- Possibility of increasing prices

2. Mushroom

- Made from argricultural waste, why no competitions
- Can be molded into the desired shape

Problems:
- For now, only suitable for smaller items

3. Seaweed



- Biodegradable
- Made into a film-like state

Coutnell, J. (2022), *Eco-friendly packaging alternatives for your business's shipping needs*, August 30, 2022, located the 8th of september: https://greenbusinessbureau.com/green-practices/products/packaging/8-eco-friendly-packaging-alternatives-for-your-businesss-shipping-needs/

Research of my product:

Milk containers

Different milk containers

Only plastic with lid:

Carton with plastic lid:

Carton with fold closure:

Tetra Pak vs. plastic

Tetra Pak uses less water in the production as well as having a lower carbon footprint.

Source: Kaye L. 2011, *Tetra Pak v plastic water bottles – which is best for the environment*, located the 12th of September: here

Pros and cons

Containers

Plastic:

- Made of one material and therefore it is recyclable
- Made from fossil fuels
- Need an extra material to market the product and for that to stick there is a need for glue.

Cardboard:

- Made of three different materials (plastic, paperboard, and aluminium) and therefore is difficult to recycle.
- Easy to print design on.

Source: SanJoséRecycles, Environmental footprint of milk containers, located the 8th of September: https://sanjoserecycles.org/environmental-footprint-of-milk-containers/

Lid

Plastic lid:

- Easy to store in the fridge both standing and lying down.
- The durability of the milk inside can be longer, but not necessarily if the folding is done correctly and ones hands are clean.

Fold closure:

- By removing the plastic lid from a carton package the CO2-emissions is reduced with 10 gram per lid, which is a reduction on 30% of the packaging per carton.

Source: Arla, *Er en mælkekarton klimavenlig?*, located the 5th of September: https://www.arla.dk/om-arla/omtanke/artikler/er-en-maelkekarton-klimavenlig/

LCA of existing packaging

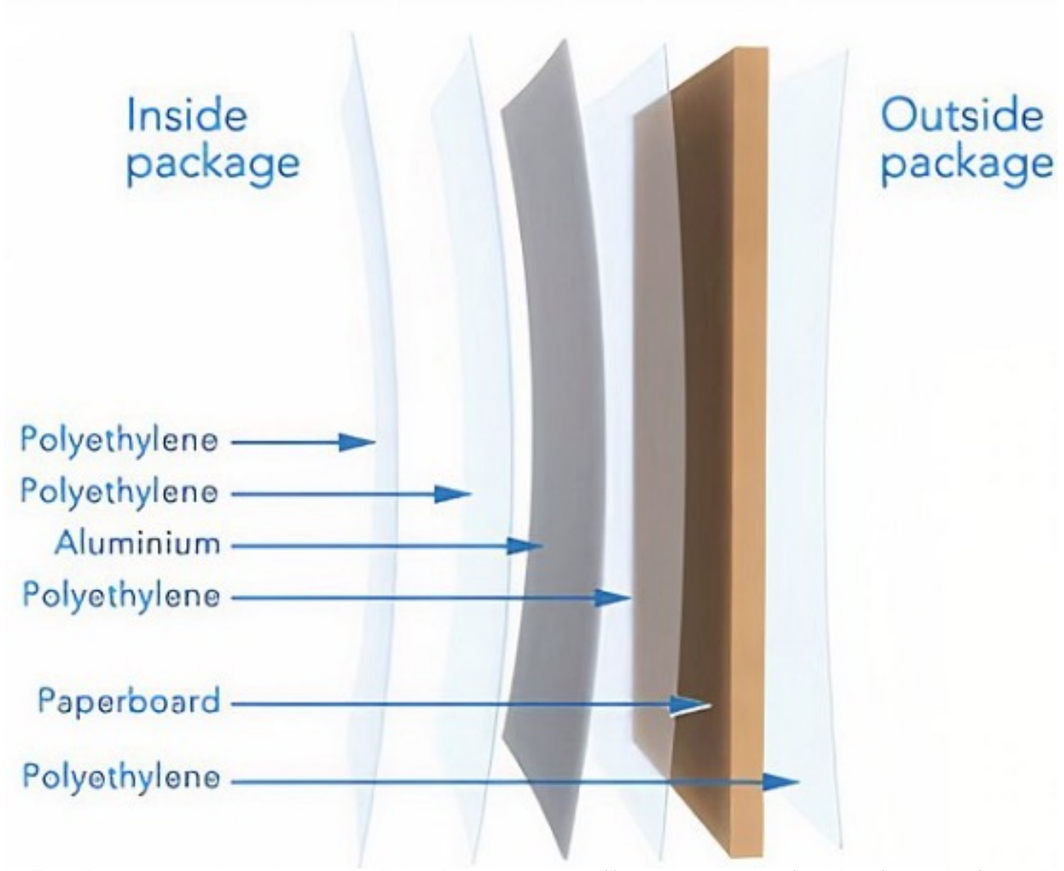
My product: Milk carton container

Carton packaging

Paperboard – main material of the carton. It provides stability, strength and smoothness to the printing surface.

Polyethylene – protect against outside moisture and enables the paperboard to stick to the aluminium foil.

Aluminium foil – protect against oxygen and light to maintain the nutritional value and flavours of the food in the package in ambient temperatures.



Source: Tetra Pak, *Packaging material for Tetra Pak carton packages*, located the 5th of September: https://www.tetrapak.com/solutions/packaging/packaging-material/materials?fbclid=IwAR0GKvlewcSKJSsvddQNAalaRoyHEONcriYbETt2XCfSmCEPxO2dxh387G4

	Extraction	Production/Manufacture
Paperboard	USA and Canada is the largest wood pulp producers, which is needed in the process of producing paperboard. (Source: here)	Paperboard is manufactured by first pulping -> optional bleaching -> refining -> sheet forming -> drying -> calendaring -> winding. China and Germany are the largest producers and exporters. (Source: here)
Polyethylene	China is the largest producer of plastic, but the oil that plastic is made of has USA and Russia as the largest extractors. (Source: here)	Polyethylene is made from a chemical reaction with ethylene and a lot of heat. China is the largest producer of it. (Source: here)
Aluminium foil	For making aluminium foil bauxite is used, and Australia is the largest country for extracting that material. (Source: here)	Germany is the largest producer of aluminium foil. Its produced by rolling aluminium through a continuous mill and then it becomes thinner and longer. The one that Tetra Pak uses is thinner than a hair. (Source: here)
Printing ink	The main ingredient in making ink is oil, either soybean oil or linseed, which makes the largest extractions countries Brazil, USA, and China. Depending on what kind of ink, it can be mixed with a large variety of substances. (Source: here)	Germany and China is the largest printing ink export countries. The ingredients is combined with pigments and then its ready to be used. (Source: here)

Distribution

The carton packaging is great for distribution in terms of space under transportation, as they can be stack side-by-side because of the rectangle shape.

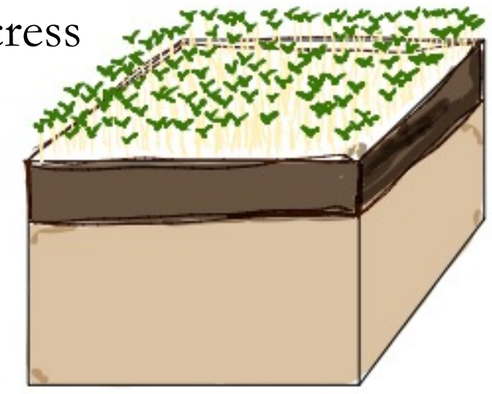
The problem is that to stack the carton on top of each other, there is a need for a carrier made in most cases out of plastic (shown in the picture). It makes is easy to carry many cartons at the same time and stack them on top and side-by-side.

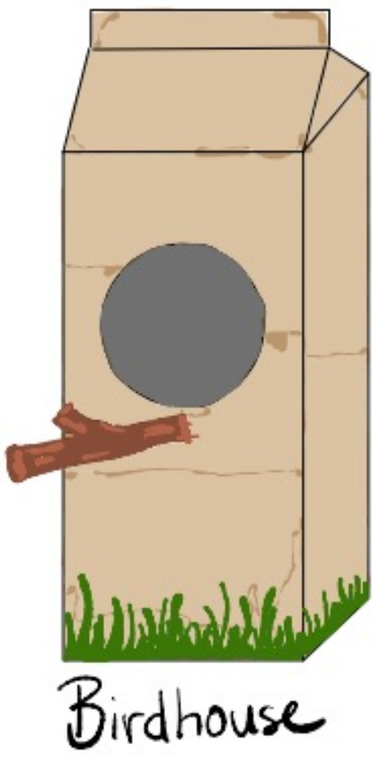
For all the materials to reach the same manufacture (example Tetra Pak in Sweden) there has probably been both a plane, boat, and truck used as transportation vehicle.

Use of Product

A carton can be used a **single time** by the product inside, but there is some secondary (**cradle-to-cradle**) use option:

- Birdhouse
- Growing watercress





A carton can be recycled, but it depends on the local recycling solutions, as you cannot separate the different martials. In Australia and New Zealand Tetra Pak is working on a recycling solution for carton, where it will be able to replace plywood, oriented strand board, plasterboard or chipboard.

Source: Tetra Pak, located the 12th of September: https://www.tetrapak.com/en-anz/sustainability/planet/carton-recycling-australia-new-zealand

Impact analysis

Extraction: 4 points
Production / manufacture: 4 points
Distribution (packaging): 15 points
Distribution (transportation): 30 points
Use of product: 10 points

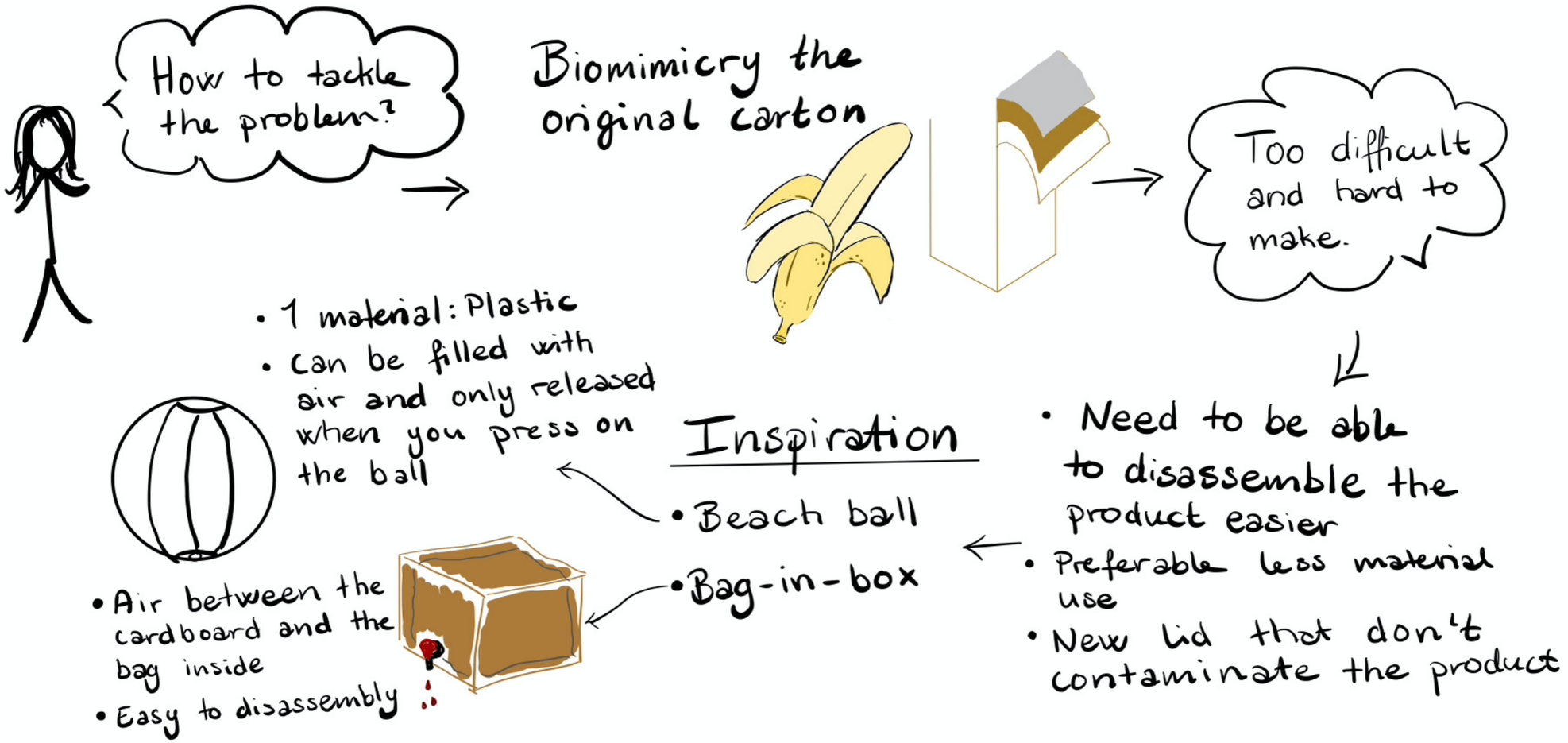
- Single use, but cradle-to-cradle options

Disposal or reuse: 5 points

The overall impact on the environment is very high with **68** total points. The biggest polluter in the LCA is the distribution of the different martials coming to one manufacture.

Sketches

Context and inspiration



Questions I asked myself

How can I make the valve in the same material as the rest of the ball/bag and still make it easy to get the product out?

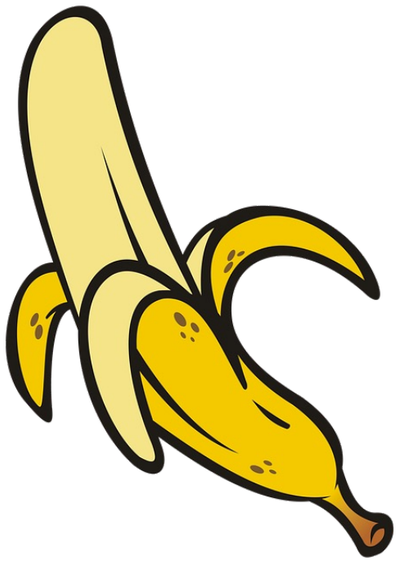
- Soft plastic as the rest of the bag, like in a bathing ball.
- Need to be on the outside of the bag for easy use.
- The product is released when there is pressure on either the bag or the valve.

Can the paperboard/cardboard be made of recyclable materials when the product inside is food?

YES! Because there is air between the plastic bag and the outer layer, why it will not contaminate the food product.

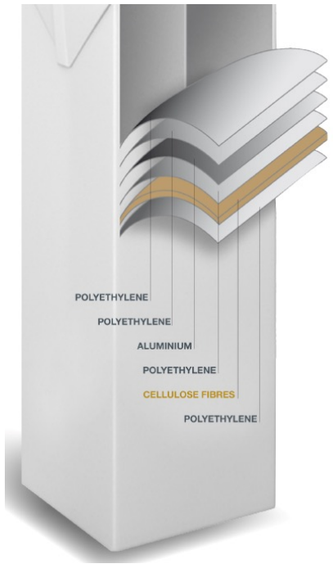
> This is also why there is no need of the aluminum layer.

Recycling and biomimicry



Disassemble the different layers as you will peel a banana

1. Tear off the top (this end up in landfill and cannot be recycled).



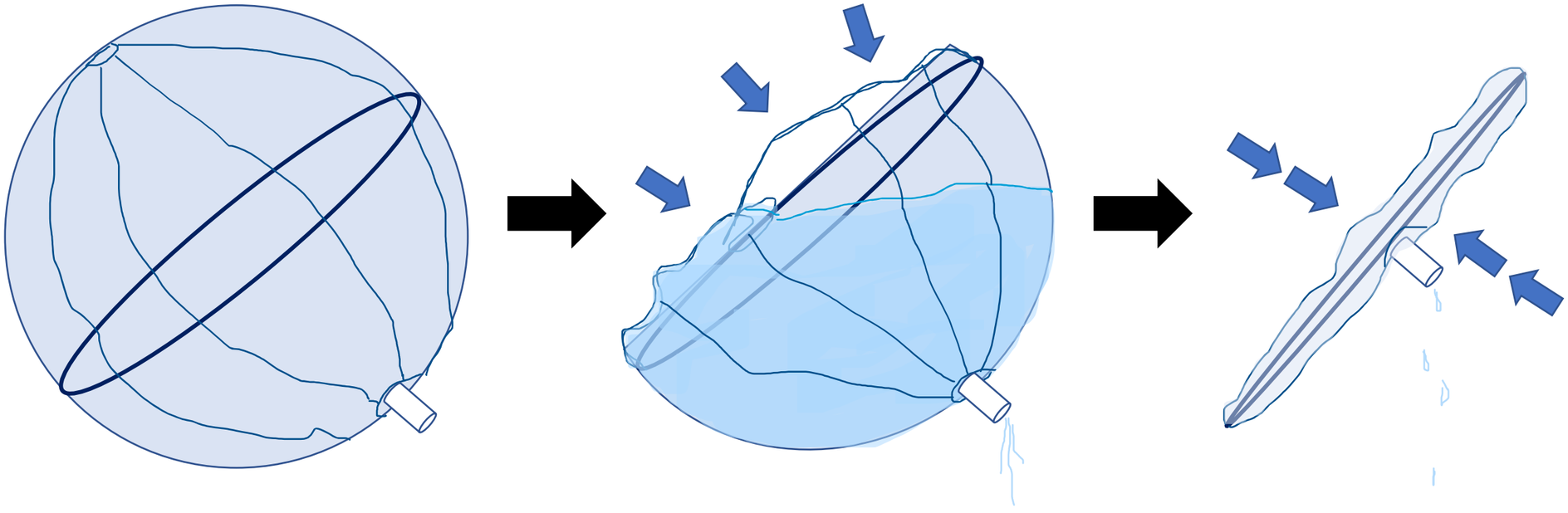
2. The layers are made so it is easy to see where to tear up.

Difficulties:

- A carton can be made of up to 6 different layers and three different materials, which make the process of peeling long and difficult.
- The layers may have to be thicker so it is actually possible to disassemble them one by one, which makes the product heavier for transportation and consumer.

New packaging solution

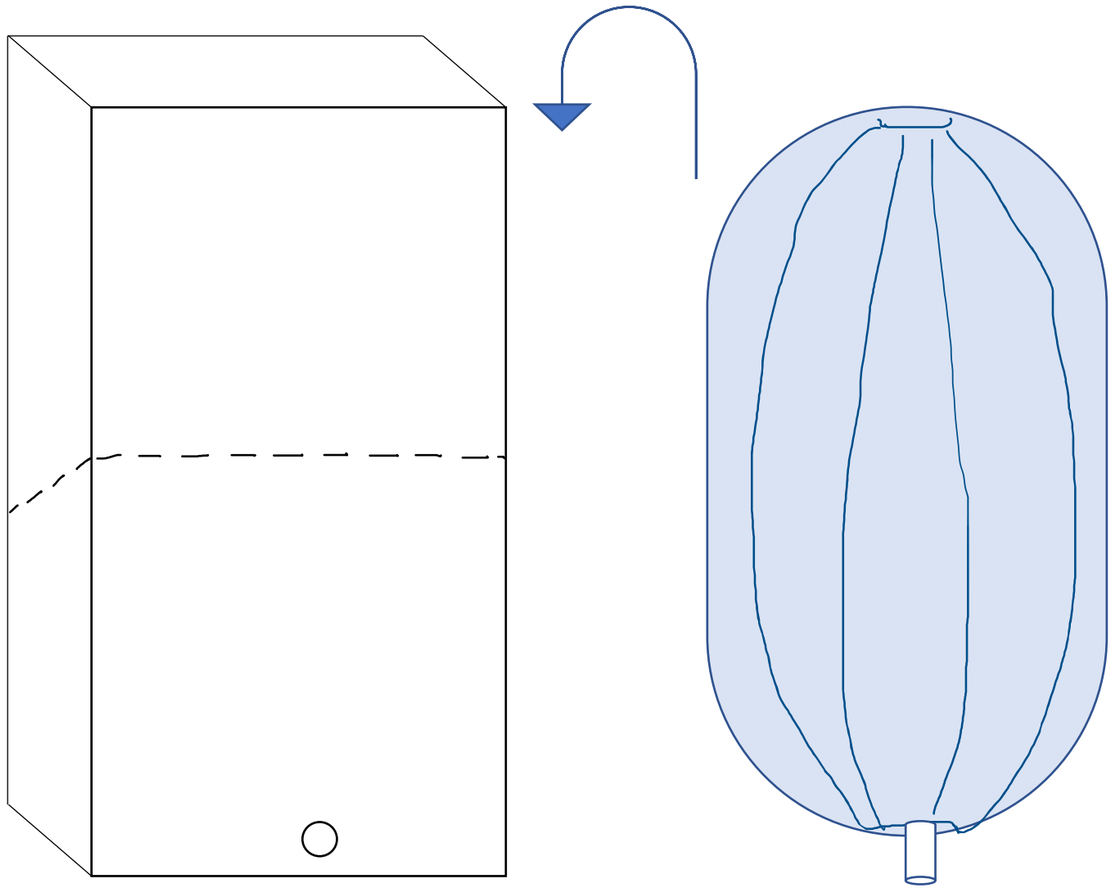
- for milk and liquids in general



Barriers it address:

The round shape with a valve address the problems with getting all the liquid out of the packaging and keeps out bacteria which increase the durability of the product inside as no acid or air comes in.

Box for the new packaging



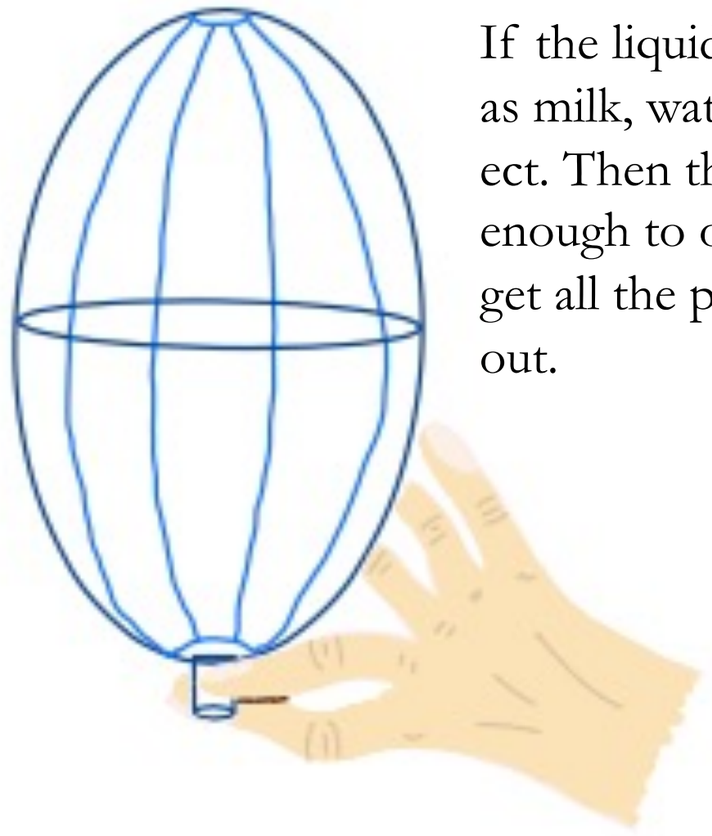
Advantages:

- Only two materials namely plastic and paperboard
- Easy too disassembly as the two materials are not attach to each other with any glue or similar product
- Easy to transport in the paperboard carton with the shape it has.

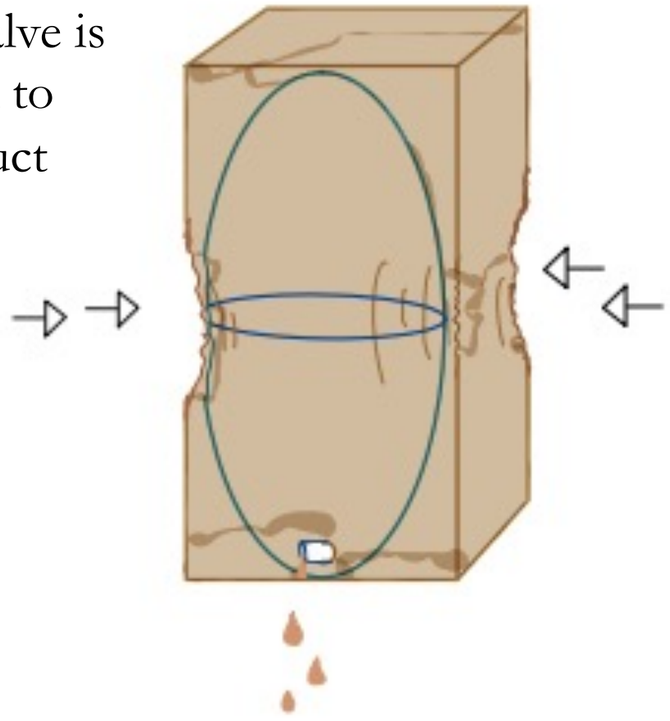
Disadvantages:

- There is some spilled areas within the cardboard carton as the liquid is in a round shape and the carton is rectangle.

No product waste

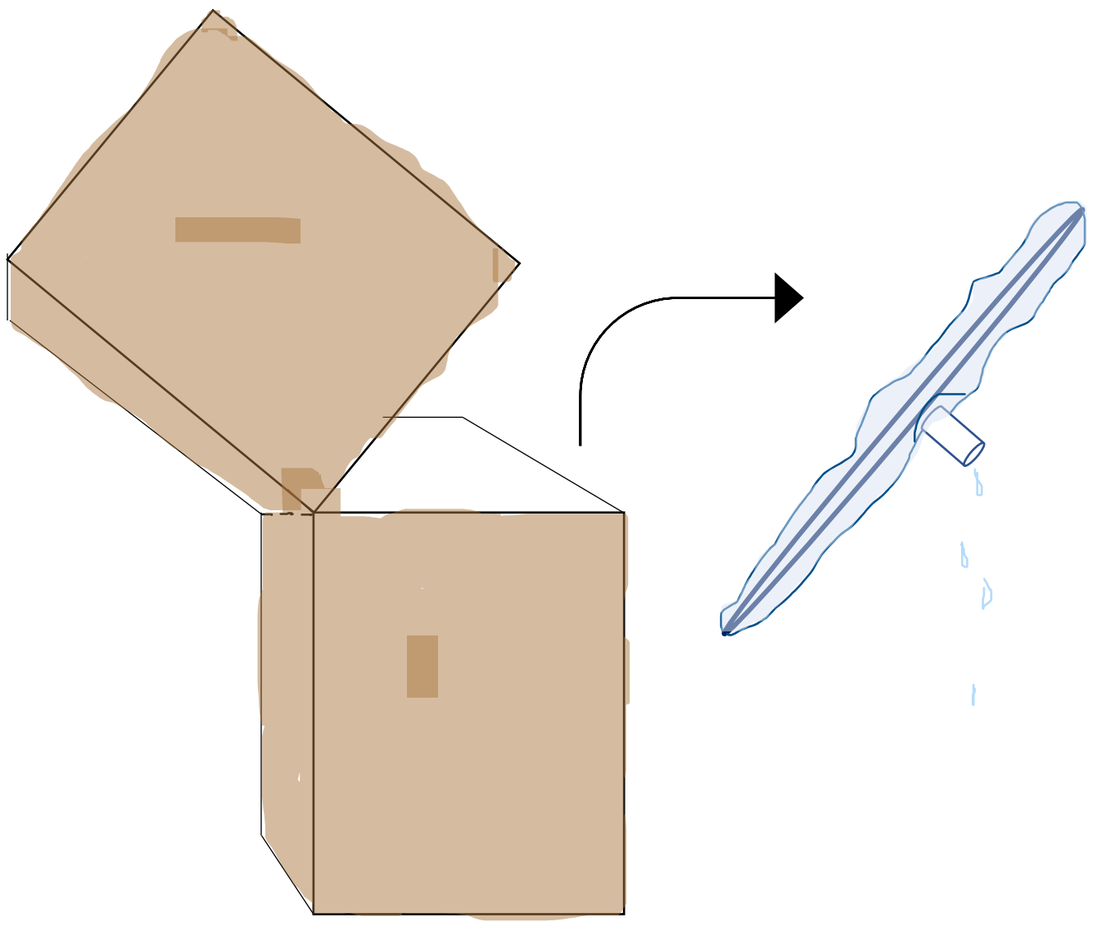


If the liquid is fluent as milk, water, juice ect. Then the valve is enough to open to get all the product out.



If the liquid is more thick like yoghurt, full cream, creme fraiche or even make-up products like concealer or day cream, then the outer box can be made in a softer material so the consumer can press on the outer box to get the product out.

Disassemble



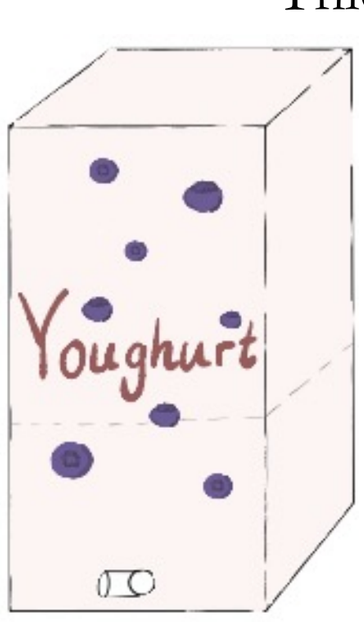
When all liquid have been used, you ”open up” the paperboard carton in the middle and take out the plastic packaging.
It’s easy to separate and recycle the two materials. The valve/lid is made from the same plastic as the rest of the packaging, so it all can be recycled as the same material.

Types of liquid

The product can be used for packaging of lots of different types of liquids:

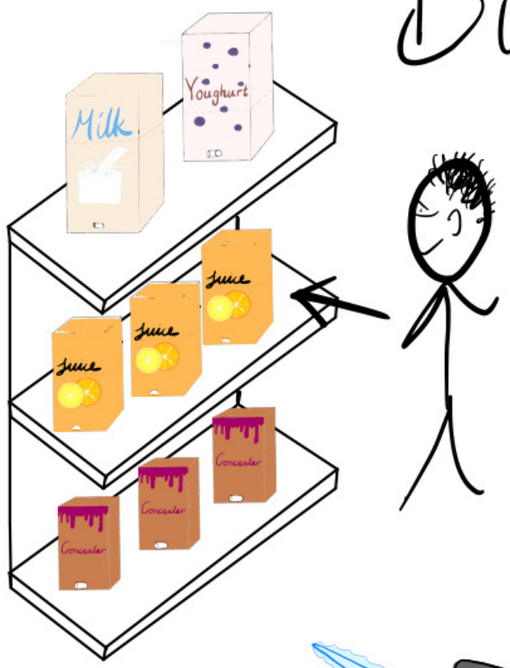
Watery liquids

Thick liquids



Other products than just food products can be from the cosmetic industry which also over package. It can be used for liquid products as concealer and day cream.

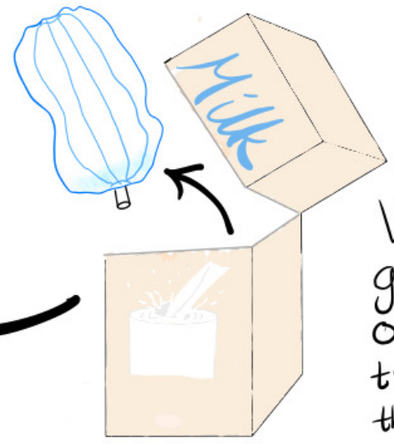
Buy - Use - Recycle

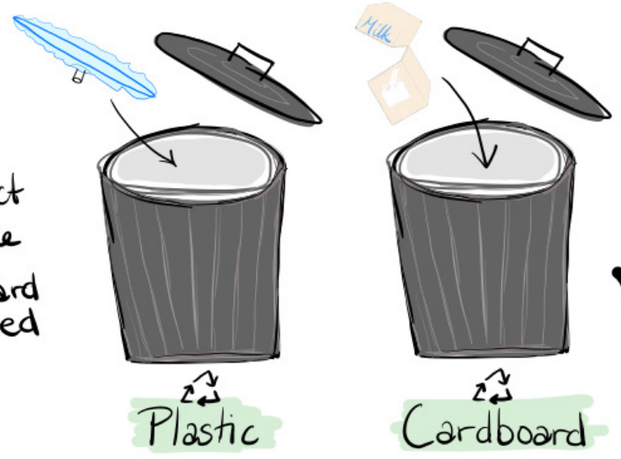


Buy the desired product.

Use the milk by tapping from the valve.

When you can't get more product out, split carton in two pieces and squeeze the last bit of product out.





When the last bit of the product is out, recycle the carton in cardboard and the compressed bold in plastic.

Prototypes

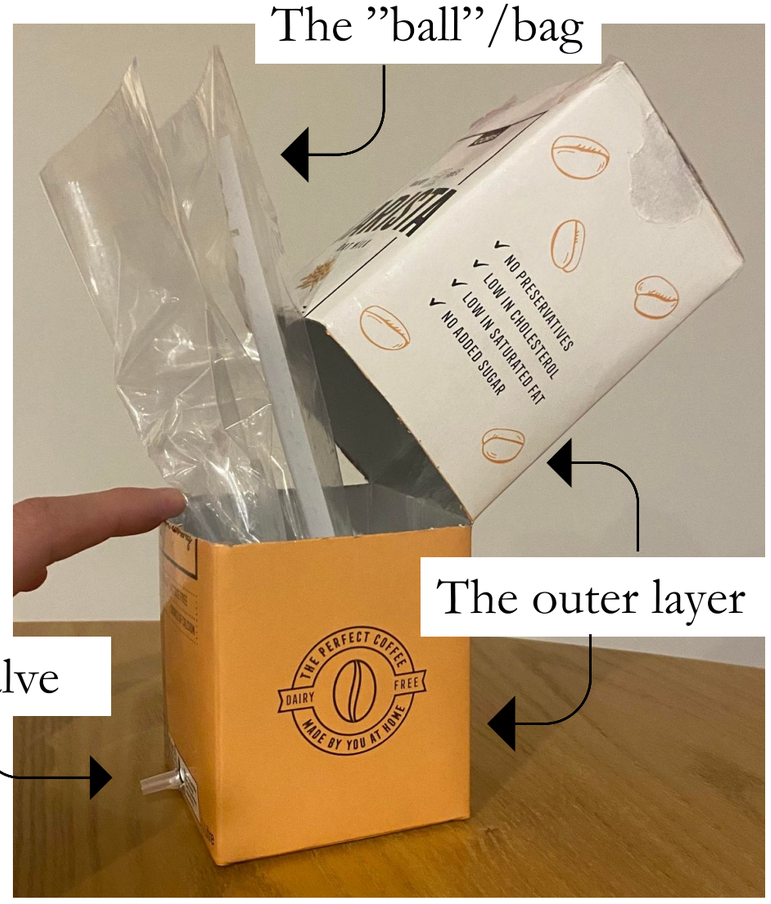
Soft model

It will be closed until all the product is used

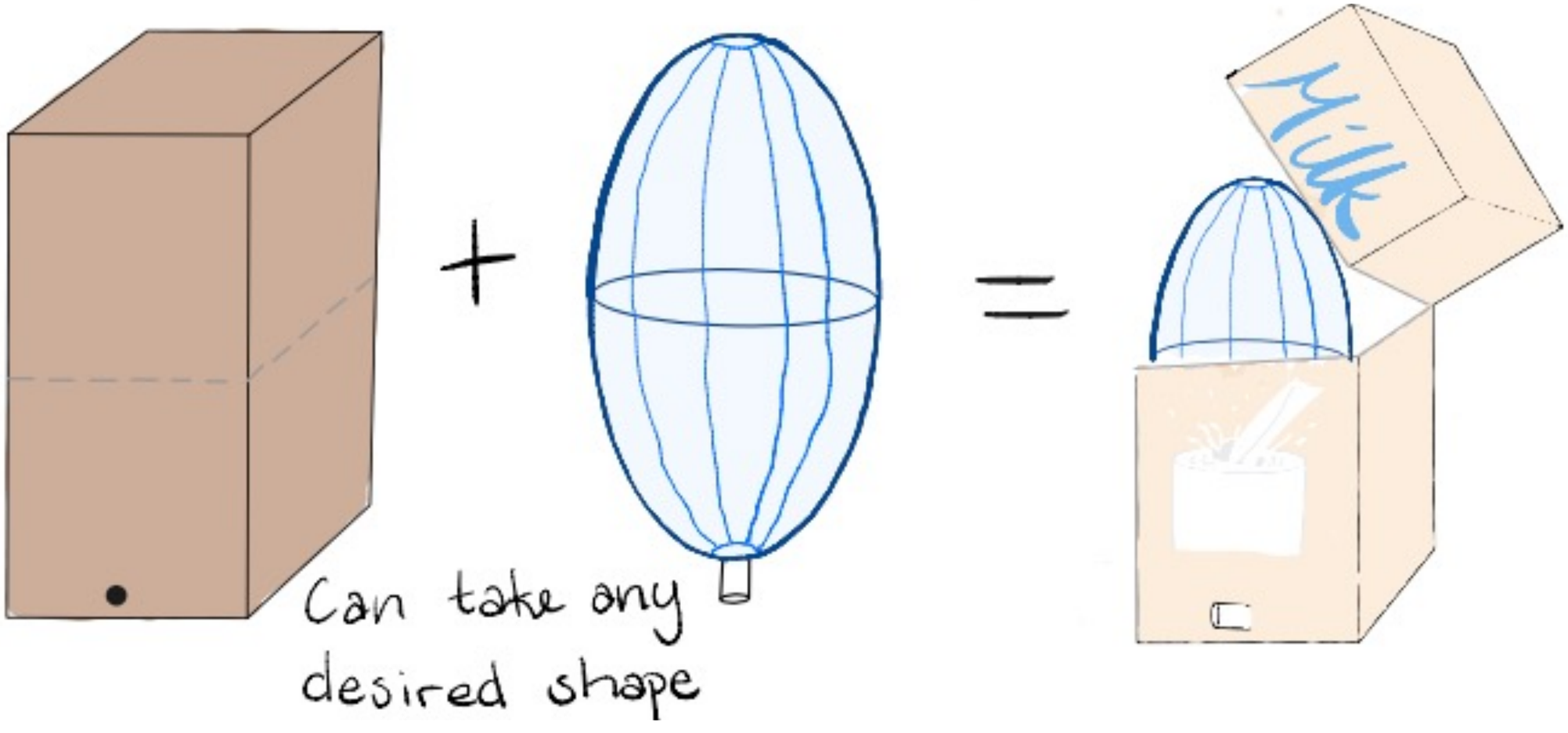
The ”ball”/bag

The valve

The outer layer



Hero images



SPG worksheet

Design strategy	Has this area been considered?	If no, why? What alternatives have been considered	If yes what interventions have been implemented
Minimise materials (source reduction)	Yes, originally the packaging consist of multiple plastic layers, aluminium and paperboard	-	Now the product only uses one layer of plastic and paperboard
Use recycled materials	Yes, Tetra Pak have different arrangement for sustainable wood and uses some recycled plastic, but not enough.	Not every food product will be able to use bio-degradable plastic, and then normal plastic must be used, but it is still only one layer.	The new product can use bio-degradable plastic for some product (like mushroom, seaweed, or cornstarch) and 100% recyclable paperboard as it don't touch the food.
Design for transport	Some liquid products is weirdly shaped, which makes it more difficult for transport.	-	This product can come in most shapes, but the smart thing is that the inside layer is round shaped and then put in the preferred shaped for the outer layer.

Minimise risks associated with potentially toxic and hazardous materials	Yes, as the original carton has either a lid or a closed folder which expose the product inside for air. Also the carton has been made under really high temperatures for it to be around food products.	-	The valve secure the product from outside contamination and make the durability of the product longer. Also only the plastic needs to be made safe for be in contact with food.
Use renewable or recyclable materials	Yes, as stated before Tetra Pak secured that there products comes from a sustainable forest, but instead they could investigate the renewable materials as an alternative.	-	The smart thing with this product is that the outer layer is not in touch with the inner layer, why the outer layer can be made with 100% recyclable materials.
Design for reuse	Now the carton packaging can be used in some cradle-to-cradle ideas, but they are more for fun than having a real use.	The new packaging is not made for reuse, but rather for making it easier to disassemble.	-
Design for recovery	It has not really been considered as the packaging is for food products, so the inside layer has been in contact with the food, why it does not really can be recovered.	The packaging is designed more for easy recycling and not for recovery. This is also because of the size of the packaging.	-
Design for litter reduction	Tetra Pak has at least 6 layers of materials, and for thicker food products it can be difficult to get all of the food product out because of the rectangle shape.	-	Litter reduction comes in the round shape off the inside ball, which makes it easy to get all of the product out. Also the plastic ball when all product is out does not take up that mush space.
Consumer Information	Yes, but it is not where I put most of my focus as the information the product gives is similar to what the regular consumer has seen before.	-	For the disassemble there are dotted lines around the paperboard to show where to open when finished with the product.

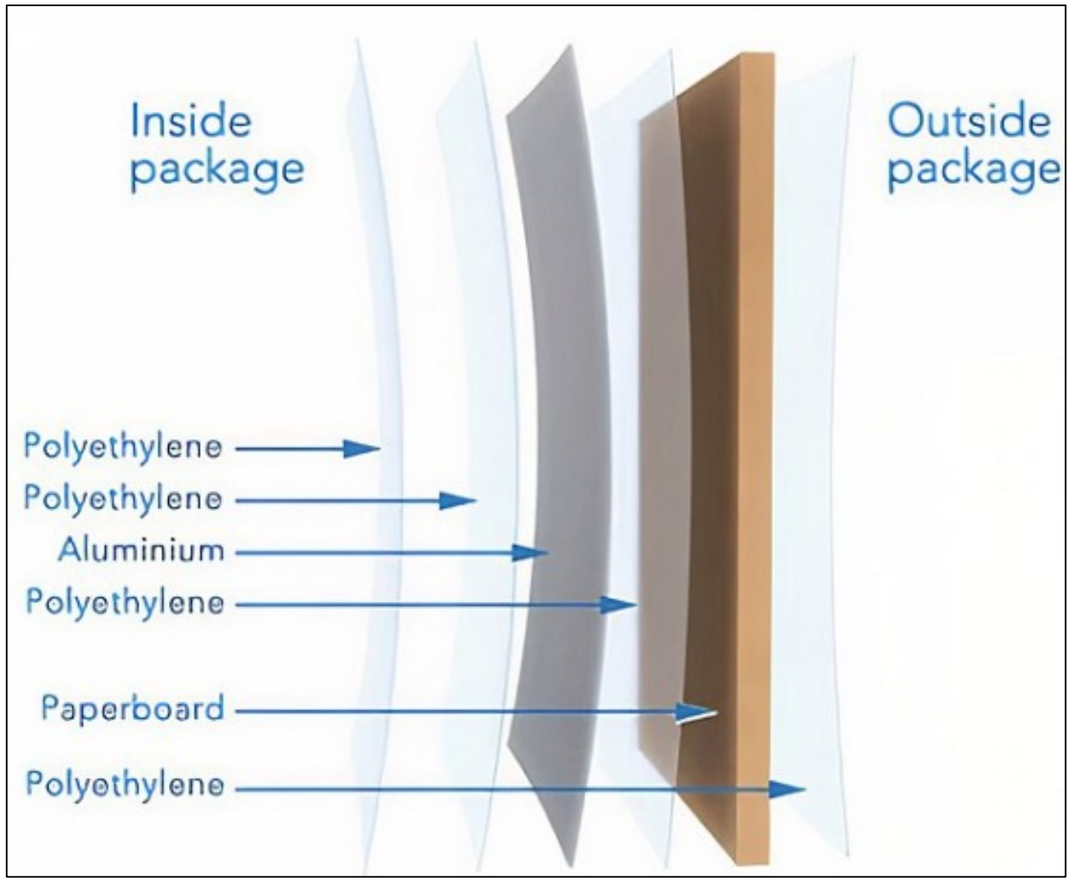
Design presentation

The problem

Todays food packaging option for milk and other liquid fluids is mostly produced by Tetra Pak if the product is in a carton.

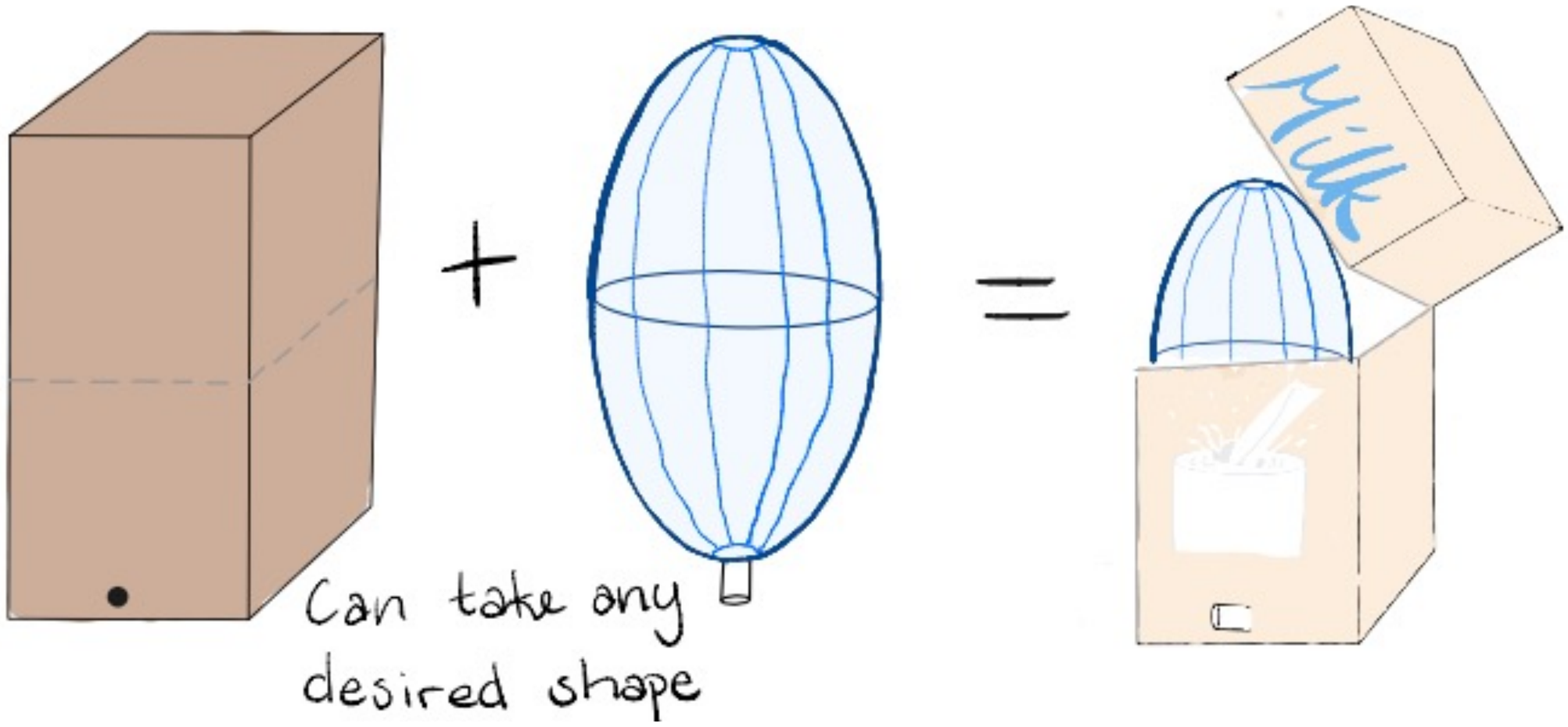
This packaging comes with different problems being:

- Multiple materials
- Difficult to recycle
- Not all materials are eco-friendly
- The product is contaminated the second the lid or fold is opened

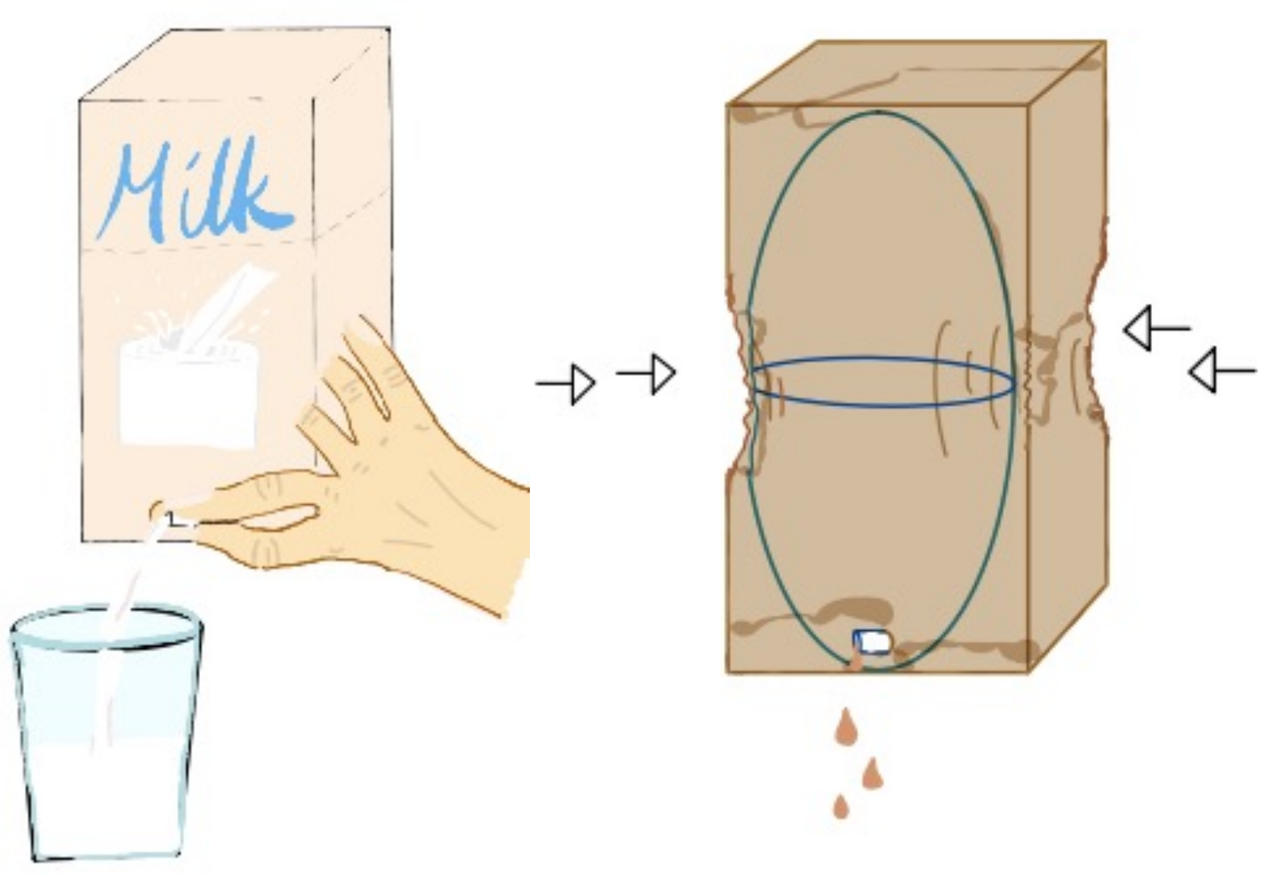


https://www.tetrapak.com/

Hero image



How it works



Types of liquids:

- For watery liquids you press on the valve to get the product out
- Thicker liquid the carton is made in a material that can be screws a bit.

Done with the product:

- Disassembly the carton box and take out the plastic ”bold”
- Recycle in plastic and paper-/cardboard.

How it solves the problem

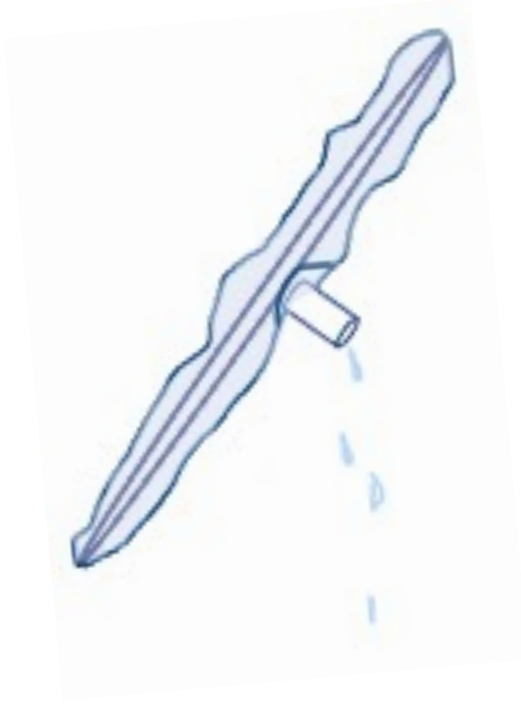
1. Only two materials are used:
- Plastic
- Paperboard/cardboard

2. Easy to disassemble and recycle

3. Eco friendly materials in both bio-degradable plastic and recycled paperboard/cardboard

4. The durability of the product is longer due to no contamination with the valve

5. With the shape of a round packaging it is possible to use all the product, so less spilled product



Folio

What I do at home to be more sustainable

1. Instead of washing my sweaters I put them in my freezer if they begin to smell. I do it for two reasons 1) The quality of the sweater becomes worse every time you wash it, as the fibbers do not benefit from being washed. 2) I save water and use my freezer I either way use electricity too cool done, the freezer helps on the smell while at the same time make it pill less, as the small fibbers freeze and then it becomes less pilling.
2. I upcycle my old clothes in different ways. If I have some old t-shirts, I tear them apart and make new bags out of them. If I have a sweater where there is a hole on the arm, I cut off the sleeves and make a vest out of it, sometimes I will sew in nice colour stings around the shoulder, where I cut off the sleeves.
3. I save all my glass bottles for my friend, as she has a little glass jewellery company where she melts different glass into earrings and necklaces.

2.

3.

Waste swap (week 6)

Waste I have at home:
- Paint
- Old tv-furniture
- Extra vacuumcleaner
- Shoes
- Paintings and frames
- Old books
- Iphone
- Ipad
- Macbook

Ida waste:
- Clothing
- Paper
- Notebooks
- Old chargers and electronic devices
- Pencils and markers
- Shoe box
- Bags
- Posters
- Letters / birthday cars
- Glass vases

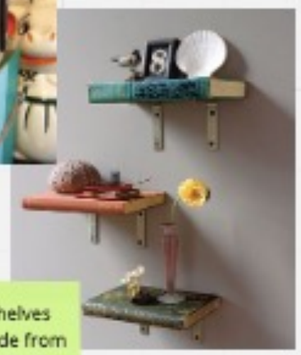
Visiting Inventor

Upcycling

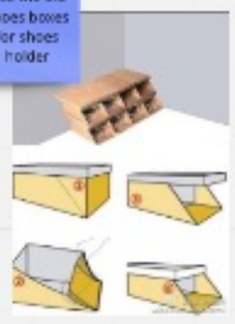
Dryed pencils and markers can color a new pencil holder, pots and bowls

Old t-shirt can be turned into a bag

Knife holder made from old books



Use the old shoes boxes for shoes holder



Shelves made from old books

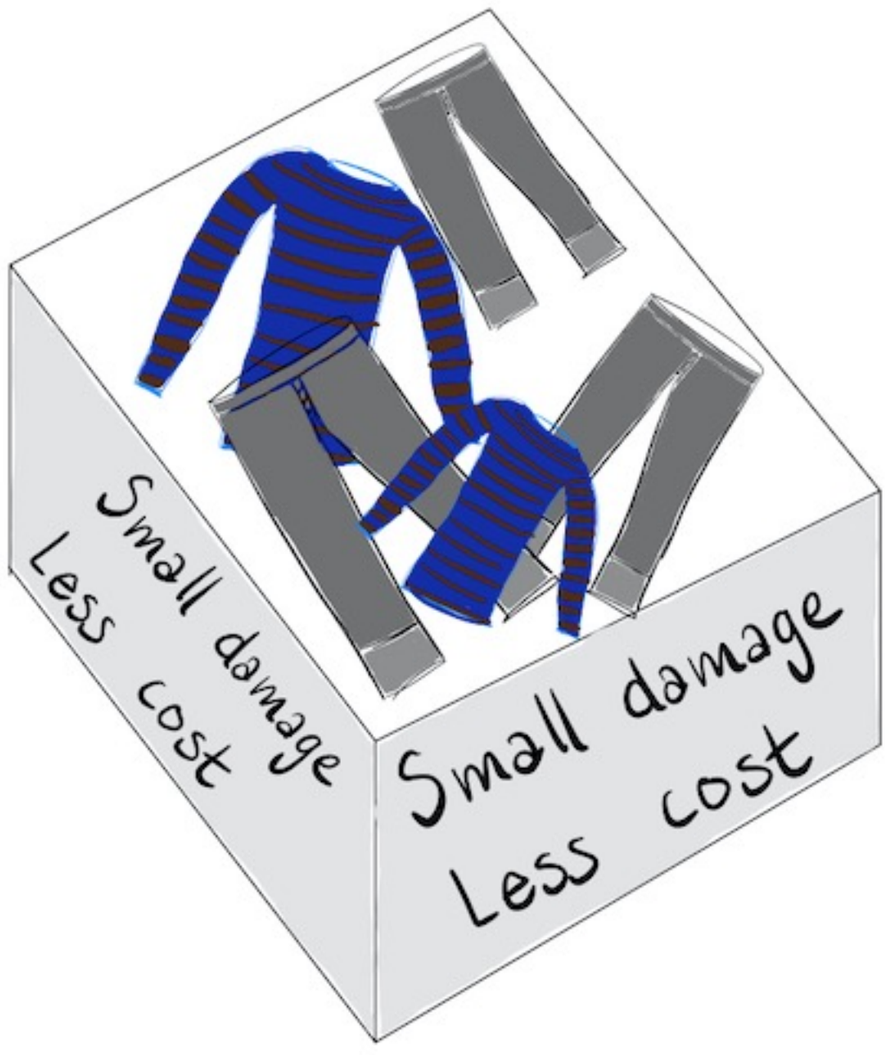
Painting over old posters and using the old frames

Paint tv stand in new color

Repairs in shops

Mads Nørgaard (A shop in Copenhagen) has a second box in the bag of the shop were people can look after treasuries to cheaper prices.
Why?

- There is a little failure on the clothing, but usually not one you will notice.
- The failure/damage is indicated with some tape
- The price is then reduced according to the failure/damage



Renew – week 7

What does renew mean to you?

- For me it means to take a thing that I may not like anymore or is damages in some way and then make it look differently or make it better than it was before. For me renew can also be putting the item in a different place, so I look at it differently and then I renew its purpose and meaning for me.

What are some ways to renew? Is repair the best or is there a better way? Is prevention better than cure?

- It can be changing, looking at it differently, upgrading it
- Repair is good if the item is damages or broken, but renew can also be an item that you don't like that much anymore and then it does not need repair but it need a change of it's look.
- It really depends on the item whether prevention or cure is the best way to go, but for most items I would say that cure is better than prevention. Until something is broken or damage it will for me not make sense to upgrade it.

Obtained inspiration, detailed advice and opinions from the collaboration with the Swedish innovator in product design Esa Mäkinen, Stockholm-Sweden.

References (1/3)

Allfoils, Aluminum Sheet and Foil 101, located the 13th of September: https://www.allfoils.com/aluminum-sheet-foil101/

Arla, *Er en mælkekarton klimavenlig?*, located the 5th of September: https://www.arla.dk/om-arla/omtanke/artikler/er-en-maelkekarton-klimavenlig/

Chand S., *Production and Distribution of Wood Pulp around the World*, yourarticlelibrary, located the 13th of September: https://www.yourarticlelibrary.com/industries/production-and-distribution-of-wood-pulp-around-the-world/25376

Coutnell, J. (2022), *Eco-friendly packaging alternatives for your business's shipping needs*, August 30, 2022, located the 8th of september: https://greenbusinessbureau.com/green-practices/products/packaging/8-eco-friendly-packaging-alternatives-for-your-businesss-shipping-needs/

Kaye L. 2011, *Tetra Pak v plastic water bottles – which is best for the environment*, located the 12th of September: here

Matthew D, Plastic vs cardboard packaging: A complex choice, May 26 2020, located the 4th of september: https://theecobahn.com/packaging/plastic-vs-cardboard-packaging-a-complex-choice/

Minin-technology, 2014 May 26, *Bauxite behemoths: the world's biggest bauxite producers*, located the 13th of September: https://www.mining-technology.com/analysis/featurebauxite-behemoths-the-worlds-biggest-bauxite-producers-4274090/

References (2/3)

Pioneer packaging, *Why is over-packaging a problem?,* located the 4th of September: *https://pioneerphoenix.com/why-is-over-packaging-a-problem/*

Riley A., 2014 March 27, *Paper and paperboard packaging*, located the 13th of September: https://doi.org/10.1533/9780857095701.2.178

SanJoséRecycles, Environmental footprint of milk containers, located the 8th of September: https://sanjoserecycles.org/environmental-footprint-of-milk-containers/

SmartSolve, Pros and cons of paper packaging, November 23, 2021, located the 4th of September: https://www.smartsolve.com/news/paper-packaging-advantages-disadvantages

Storage containers, Advantages and disadvantages of metal storage containers, August 30, 2012, located the 4th of September: https://www.haulaway.com/blog/2012/08/advantages-and-disadvantages-of-metal-storage-containers/

Sharpe, P. 2015 Sepember, Making Plastic: From Monomer to Polymer, located the 13th of September: https://www.aiche.org/resources/publications/cep/2015/september/making-plastics-monomer-polymer

References (3/3)

Tetra Pak, located the 12th of September: https://www.tetrapak.com/en-anz/sustainability/planet/carton-recycling-australia-new-zealand

Tetra Pak, *Packaging material for Tetra Pak carton packages*, located the 5th of September: https://www.tetrapak.com/solutions/packaging/packaging-material/materials?fbclid=IwAR0GKvlewcSKJSsvddQNAalaRoyHEONcriYbETt2XCfSmCEPxO2dxh387G4

The European container flass federation, *Why choose glass?,* located the 4th of September: https://feve.org/about-glass/

Tiseo, I., 2022 Jan 12, *Plastic material production worldwide by region 2020*, statista, located the 13th of September: https://www.statista.com/statistics/281126/global-plastics-production-share-of-various-countries-and-regions/

WWF Australia, located: here

1ink, 2017 Apr 19, *What is Printer Ink Made Of?,* located the 13th of September: https://www.1ink.com/blog/what-standard-printer-ink-is-made-of-1inkcom/