COMPANY / PACKAGING PRIMARY RESEARCH

RPC is a global design and engineering company, with plastic products at the forefront of their brand. The company centralises their operations in product packaging, whilst also manufacturing non-packaging products: establishing them as one of Europe's largest suppliers of plastic packaging (with an annual turnover of £3.7bn).

With current global warming circumstances and a growing environmental awareness of the impacts of plastic production, RPC has developed and manufactured a number of recyclable packaging solutions, and are currently researching into **bioplastics** and other **biodegradable** polymers, as well as multifunctional/ **reusable packaging.**

Recyclable polymers

Polymer	Description	Uses	Sustainability
Polyethylene Terephthalate (PET)	Polyethylene Terephthalate is a general-purpose thermoplastic polymer which belongs to the polyester family of polymers.	It is an important commercial polymer having uses ranging from packaging, fabrics, films, molded parts for automotive, electronics, etc.	PET is one of the most recycled thermoplastics in the world, Almost 1.8 billion pounds of PET were recycled in 2015, used to make a variety Of end products.
High Density Polyethylene (HDPE)	Polyethylene is one of the world's most popular plastics. It is a highly versatile polymer with multiple applications from damp proof membranes for new buildings to light, flexible bags and films.	Chemical drums, Jerri cans, toys, picnic ware, household and kitchenware, cable insulation, carrier bags, food wrapping material.	What makes HDPE plastic a sustainable material is that it's made from post-consumer materials. Roughly 25-100% of HDPE has been recycled and refurbished.

Benefits of Reusable packaging

Reusable packaging being more durable and robust also tends to offer better protection of the products or parts within. Reusable packaging can also help to minimise C02 emissions through more efficient transit. When loaded, this can be through stacking and space efficient sizing. When empty, they can usually be collapsed to prevent the shipping of empty space: This has benefits for storage too.

Specific reusable packaging such as **'Correx'** can also offer weight and volume savings, both of which can also help with reducing transport emissions.

Potential Plastic Manufacturing Processes

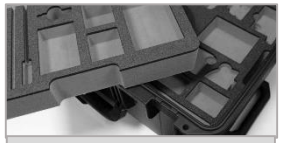
Injection moulding uses a mould made from aluminium or steel. The mould is placed into a plastic injection moulding machine which heats the raw plastic resin pellets until they're molten, injects them into the empty the mould under great pressure, and then opens to eject the finished part. The advantage of this process is that large quantities of identical parts can be made quickly, with a nice surface finish and at a low cost.

Thermoforming is a type of vacuum forming, where a thin or thick gauge plastic sheet is placed over a die, heated to a high temperature, then stretched over the surface of the die while vacuum pressure pulls the sheet down and into its final shape. This process is ideal for compartmentalised packaging (clamshell packaging) and can be done using simple dies and basic equipment.

Multi-Trip Plastic Packaging

Plastic packaging – which makes up the majority of returnable / reusable packaging – has come under fire from all angles over the last 12 months. Whilst businesses begin to focus on recyclable packaging solutions such as corrugated cardboard and other biodegradable materials, single use plastics have, been labelled as bad for the environment. However, returnable packaging such as supply chain totes and containers can actually be amongst the most sustainable forms of packaging currently available.

Examples of sustainable 'multi-trip' packaging → Benefits of these examples



Foam inserts
foam inserts manufactured from Plastazote, within a protective case or other exterior packaging provide high levels of protection and reduce costs of transit damage

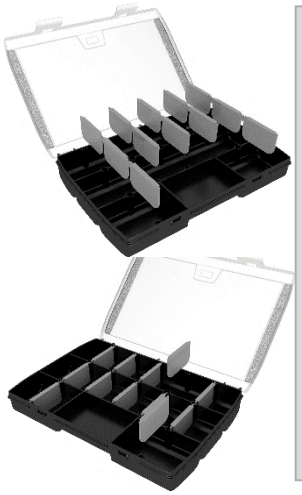
Euro Containers
these rigid plastic containers are light, hard wearing and offer a cost effective yet long lasting solution to single use packaging. They can also be enhanced with inserts, dividers, foam, etc.

Foam inserts have multiple benefits, both economically and environmentally: manufacturers are turning to foam inserts and dividers to protect components during handling that occurs during manufacturing processes, furthermore, software and performance calculations can create custom case inserts which offer a precise level of protection – reducing damage costs. Environmentally speaking, fixed protective inserts replace the need for single-use protection alternatives such as bubble wrap or paper stuffing. Surrounding the foam inserts, rigid plastic containers such as euro containers offer additional level of protection, and their robust properties offer a long lasting alternative to single-use packaging – helping to reduce plastic waste and landfill volumes affecting the environment. The containers stackable possibilities also reduce wasted space in transportation.

Bibliography

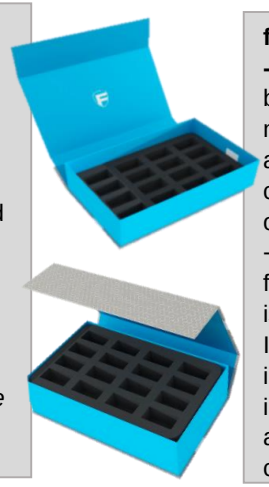
- https://www.gwp.co.uk/advantages/reusable-packaging/
- https://en.wikipedia.org/wiki/RPC_Group
- https://www.rpc-group.com/corporate/about-us

SECONDARY PRODUCT RESEARCH + INITIAL & DEVELOPED SKETCHES



feldherr half-size compartment box
- This storage/ tool box is entirely made of plastic and features a number of adjustable fixtures which act as compartment dividers, these dividers can also be removed entirely for maximum space in the box.
- The box also features a hinged lid with a fixed closing mechanism.
- The product appears to have been manufactured through processes such as injection moulding or thermoforming.

In my own project I would like to incorporate similar features to those of this product, like the ***plastic compartment dividers*** *and* ***secure hard plastic lid.***



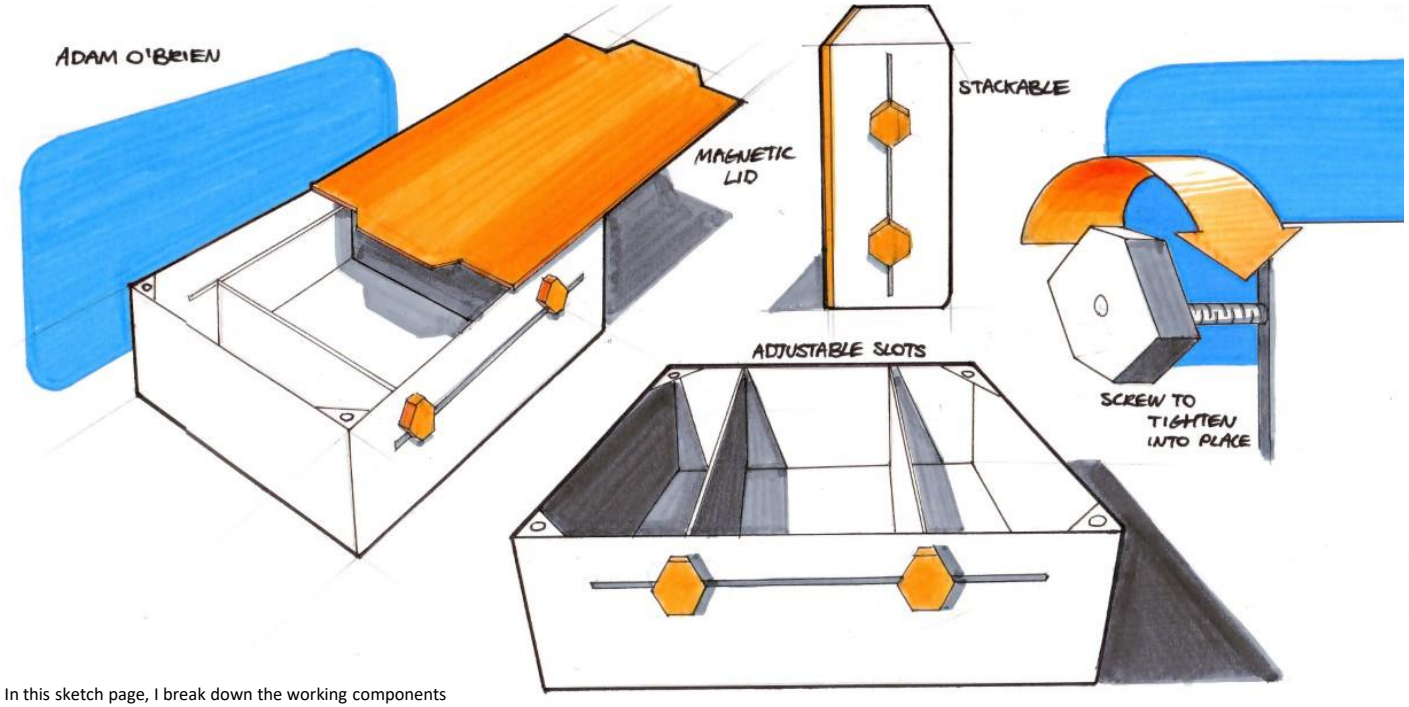
feldherr magnetic compartment box
- This storage box is made from carton board, plastic and foam, and features a number of fixed foam compartments within a carton board box. These foam compartments are also stackable; optimising all storage space within the box.
- this box also features a closable lid which folds over the sides and top of the box and is held in place by magnets.

In my own project I would like to incorporate the use of magnets to fix my lid in place as I think this would be efficient and would save space without the need for clips or hinges.

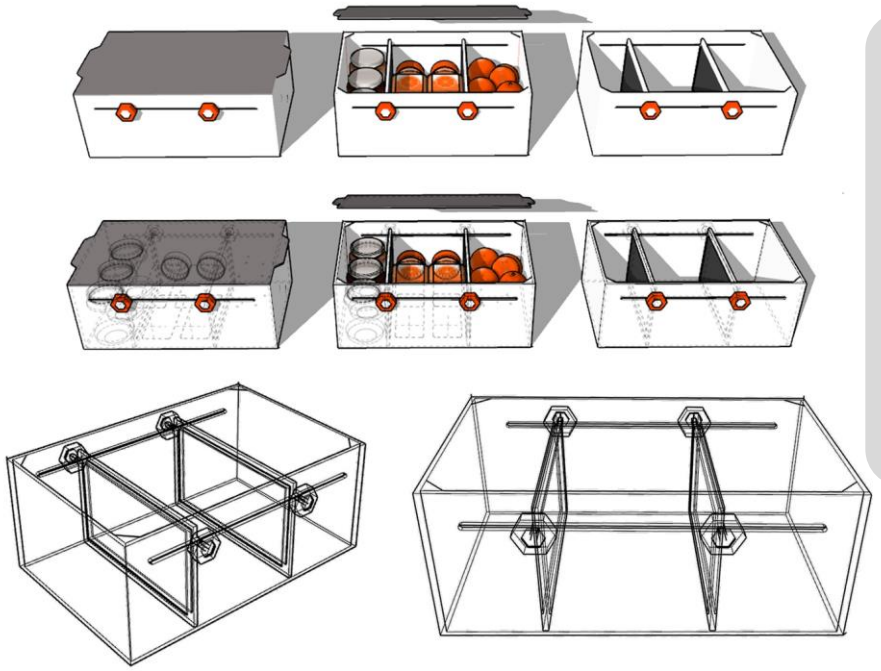
THE DESIGN PROCESS

Taking from my primary research, I gathered a greater understanding of the product brief, what other similar products on the market are offering, and differing features of these products that I can reference in my own designs; I took inspiration from common euro containers, they are durable and functional and their rigid plastic structure makes them long lasting – minimizing the demand for single-trip packaging. Euro containers also feature plastic dividers so that multiple items can be shipped in the same box, reducing wastage and cost-effectively maximizing storage space.

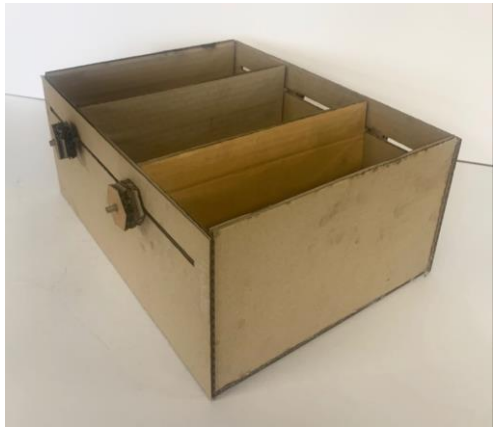
My concept for the product is a reusable storage/shipping box with divided sections within: the compartments that the plastic dividers create can be manually changed to any size depending on the product(s) being shipped. These dividers also act as a tight and protective wall around products of varying sizes – stopping them from moving around within the box which reduces damage costs, and replacing the demand for single-trip protection alternatives like polystyrene or foam pieces. Knobs on either side of the 2 dividers will allow the user/ courier to slide the hard plastic pieces inside the box, back and forth along the cutout sliders in the side of the box. When the dividers/ protective walls are tightly up against the product(s), the user can screw the knobs to tighten them against the box – ensuring that they will not move within transit. The box will have a fully removable lid, which attaches by corresponding magnets in all four corners: this is a durable and strong closing mechanism and the fully removable possibilities allow for an easier packaging process.



In this sketch page, I break down the working components of the product and display the box in all states.



These are digital renderings of my product that I created on google sketch up: they show the product in all three stages of its intended shipping lifecycle – empty, packaged, and in transit. I have shown the product in three viewing styles to show clearly the entire structure of the box and also a real-life viewing render.

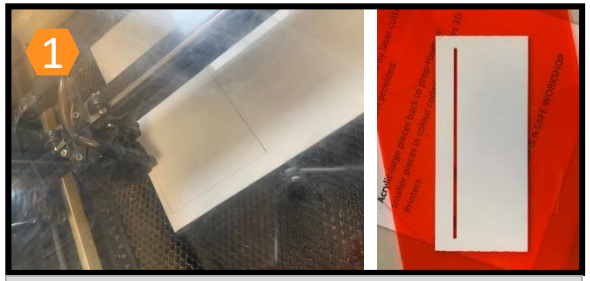


I created this model using only cardboard and hot glue as its purpose was for a reference of scale and functionality

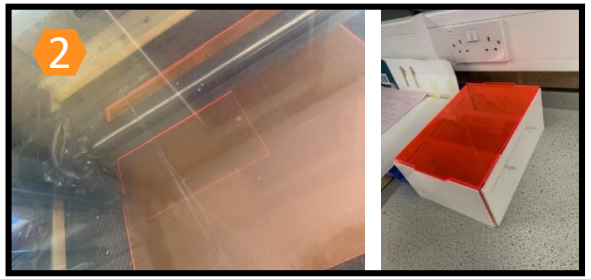
Before manufacturing the final prototype for my product, I decided to make a cardboard model to test the scale and assembly. By producing this cardboard model, I could identify problems with the design that I couldn't identify on a digital file: After laser cutting the cardboard to the original scale, I realised that I would have to create a **scale model** in the final prototype as the large size of the box would require an abundance of expensive materials to complete and would take too long to manufacture by hand. Furthermore, I realised that the initial lid design would not work as it had no handles to allow the user to lift it from the magnets, which I later redesigned before creating the final product prototype.

The final prototype is made to a scale of **1:2** to the real production product.

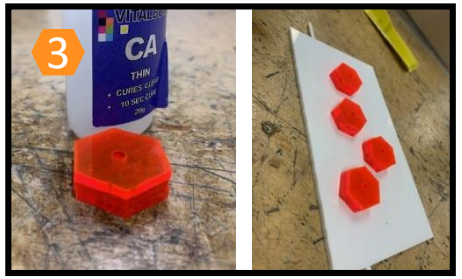
MANUFACTURING DIARY



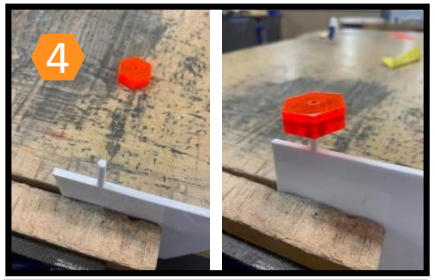
After using CAD programs to digitally draw and comprise all of the pieces I would need to manufacture the box, I used a laser cutter to cut out all of the individual pieces on 3mm acrylic plastic. I chose to use digital software and machinery to cut out the pieces as it is more time efficient than doing it by hand, and ensures that all of the pieces are the correct measurements and are made to a high quality.



As the rest of the box was cut in white acrylic, I decided to cut some of the pieces from a phosphorescent orange coloured acrylic sheet. I used this colour for the lid of the box, and the tightening hexagonal caps on each side of the box. I chose to use acrylic plastic as the main material in my project as it is a highly durable and easy-to-work material, it does not take easily to scratching and can be cut and finished quickly and easily whilst still having an aesthetically pleasing finish



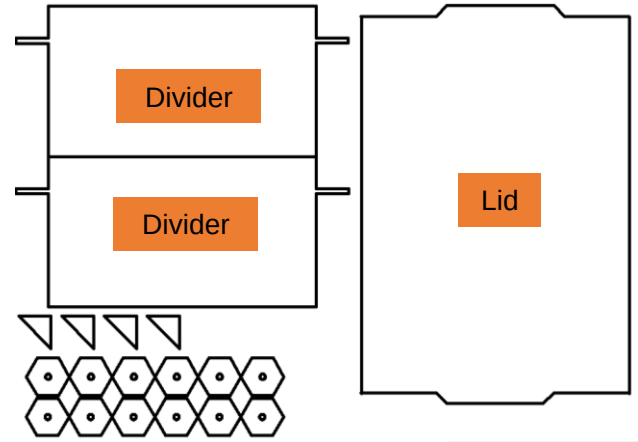
After laser cutting the hexagonal tightening knobs, I needed to glue the three 3mm pieces of acrylic together for each one to achieve the 9mm thickness for ergonomic purposes. To do this I used a thin bonding superglue on the joining surfaces of the pieces, held them together, and let them dry.

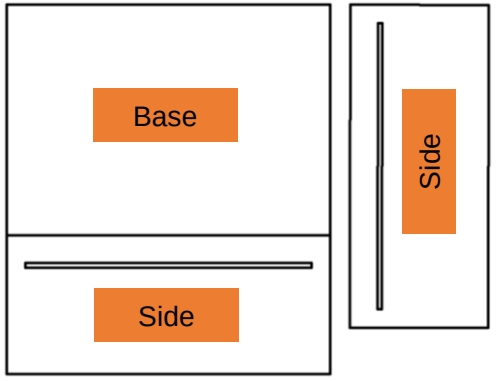


So that the knobs would fit on the dividers and be able to spin into place, I sanded the fittings on the sides of the dividers into a cylindrical form that would allow the circular hole in the knobs to fit over them tightly.

To build the main body of the box and hold all the pieces in place, I used fusion acrylic adhesive which I applied to all the adjoining edges and clamped tightly in place at 90° angle until fully dry.

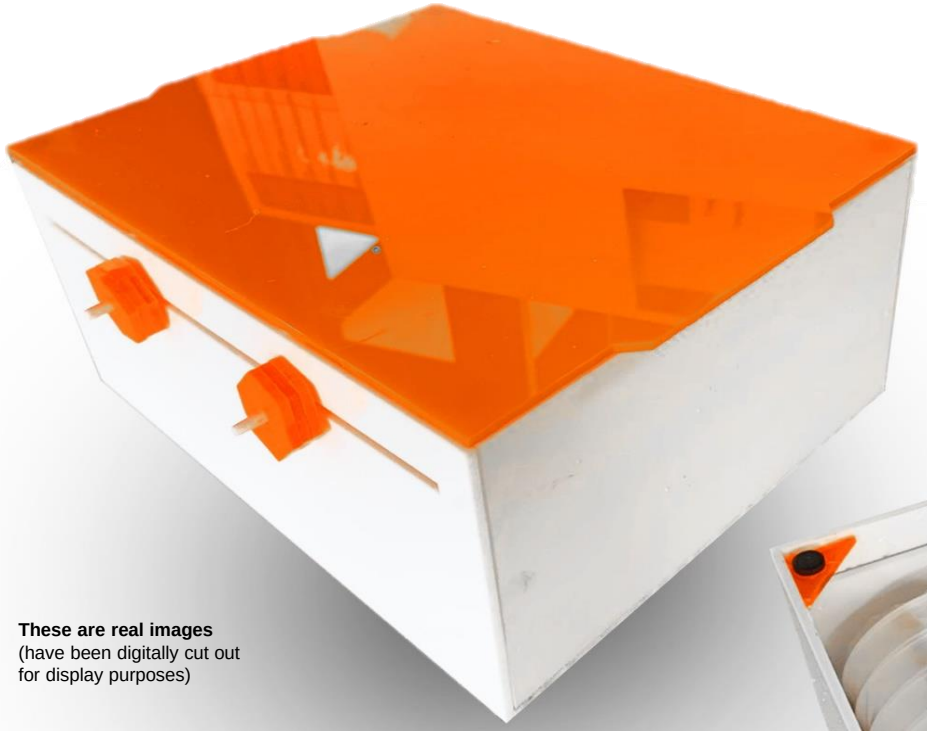
The final step in the manufacturing process was adding the magnets to the lid and inside the box to allow the lid to attach securely to the box. I did this by using a thin vitalbond glue to attach 8 small magnets to their corresponding acrylic pieces: I attached four to the underside of the lid in all four corners, and the other four to triangular corner pieces that align with the magnets on the lid.





These are the CAD digital files that I created **on 2D design V2**, I used these files to laser cut the acrylic pieces. CAD software ensured that all of the pieces were cut precisely and congruently, and all edges were smooth and at 90 degree angles to each other.

FINAL PRODUCT



These are real images
(have been digitally cut out for display purposes)

FINAL PRODUCT EVALUATION

I am pleased with the final outcome of my prototype and the product's design as a whole: I feel that the reusable and adjustable box design fulfils the client/project brief and provides a somewhat solution to a growing wider issue – single trip postage packaging and its environmental implications. The purpose of the product that I designed is to replace the need for an abundance of custom-sized postage boxes for a myriad of varying sized products globally – my design solves this issue by having adjustable packaging walls within a single sized box, so that the majority of smaller-sized products from ecommerce stores can all fit within the same sized box. The box can be returned to the courier and reused multiple time times which decreases the quantity of the product needed to be manufactured: having both environmental and economic benefits. Furthermore, the product's sturdy hard plastic shell and triangular reinforced corners mean the box can be handles like a regular cardboard box without the risk of damage. The product's rectangular shape means that multiple boxes can be tightly stacked atop one another, which reduces wasted space in transit and therefore reduces the quantity of transit journeys taken, having huge environmental benefits.

PRODUCT LIFE CYCLE

My product will be expected to fulfil its function as a reusable, returnable postage container box for at minimum of 5 years and an expected 10 years, due to the durability of the product, it is not expected to be damaged or to tarnish quickly when being handled. If the product was to go into a large scale mass production I would hope for the main components of the box to be manufactured in a recyclable plastic like Polyethylene Terephthalate or High Density Polyethylene to ensure that the product will not pollute the environment once it has extended its life cycle.

AESTHETICS

The product was finished to a high quality, and the materials used to produce the box look polished and aesthetically pleasing. I think design of the product is user-friendly; I feel like the intended colours on the usable components indicate how to use the product and make for an easy user experience.

ADAPTABILITY

The product can also be adapted and marketed at other companies offering delivery services: the colour scheme and exterior design can also be tailored for these companies. i.e. **ASDA**