

RPC

RPC is based in the United Kingdom, and is one of Europe's largest supplier of plastic packaging. They are constantly trying to innovate and create better adaptations of previous designs that are eco friendly. They quote that 'All plastics are recyclable and can be used for a variety of valuable second-life applications. Our own initiatives have seen the incorporation of recycled HDPE, PET and PP into industrial, personal care and paint containers.' which drives their want for a recyclable product to be manufactured.

RPC's commitment to sustainability is evident throughout their products' lifecycles. They aim to make a contribution at every stage, from efficient transportation and effective product protection to collaborative initiatives for reuse and recycling. They use sustainable polymers to ensure that their products are the most environmentally friendly but the most practical that they can make them.

RPC was a pioneer in the development of one of the UK's first plastics recycling schemes and we continue to work with a variety of industry and government organisations to promote plastics recyclability and improve collection rates. Where plastics cannot be effectively recycled, we advocate incineration for its excellent energy properties that can make an effective contribution to the generation of electricity.

The primary role of packaging within the retail environment is to protect, secure and deliver the product contents. RPC offer customers the most appropriate sustainable solution for their product in order to minimise environmental impact at this stage of the supply chain. The foundations for this have been achieved at the design, development and innovations stage which determines the impact throughout the rest of the supply chain.



MEAL PLAN DELIVERIES

- Ecommerce food delivery is where a person cooks and offers meals or kits via their website, which are then directly sent to consumers. The consumer chooses which meal and how many meals they want sent to their office or home, and pays depending on the meals or the program they are interested in. People choose to order meals from other people for different reasons: not wanting or having time to cook, wanting to eat home-cooked meals, or to lose weight by eating healthy foods. Examples of this type of service include Dine Wise, NutriSystem, Chef's Diet.
- The online food ordering market has increased in the U.S with 40 percent of U.S adults having ordered their food online once. The online food ordering market includes foods prepared by restaurants, prepared by independent people, and groceries being ordered online and then picked up or delivered.
- This is an ideal target market to provide a flat pack delivery due to its very rapidly growing nature. People have increasingly busy lives so therefore rely on these services provided to help them with meal planning. Due to the amount of people that use these services a reusable packaging would be ideal for these companies. It will save money by cutting down on costs and reduce the carbon footprint of the company overall.

gousto

diet
Chef

Nutrisystem®

PRINCIPLE MARKET

RPC has a very large principle market which they provide packaging for. Below are some examples:

- Beverage
- Food
- Non-food
- Healthcare
- Personal care
- Technical components

As I am wanting to design packaging for food I would like to use safe plastics that are food grade standard as well as recyclable. This will allow the packaging to be used with fruits and vegetables that don't need extra plastic coverings. Some examples of food grade plastics are:

- Polyethylene Terephthalate (PET)
- Polypropylene (PP)
- High-Density Polyethylene (HDPE)
- Low-Density Polyethylene (LDPE)
- Polyethylene (PE)
- Polycarbonate (PC)

SUSTAINABLE PLASTICS

- Plastics have a very good environmental profile. Only 4% of the world's oil production is used for plastics and much less energy is used to produce it compared to other materials. Plastics are durable yet lightweight and thus save weight in cars, aircraft, packaging and pipework.
- A sustainable polymer is a plastic material that addresses the needs of consumers without damaging our environment, health, and economy. To do this, researchers are working to develop polymers that, when compared with their non-sustainable counterparts:
 - use renewable feedstock's, such as plants, for production
 - use less net water and non-renewable energy in production
 - emit less greenhouse gases during production
 - produce less waste in production
 - have a smaller carbon-footprint
- sustainable polymers can be obtained through chemical modification of natural polymers, such as starch, cellulose, or chitin .Bio based polymers can also be synthesized through a two-step process from biomass (lignin, cellulose, starch, plant oils).

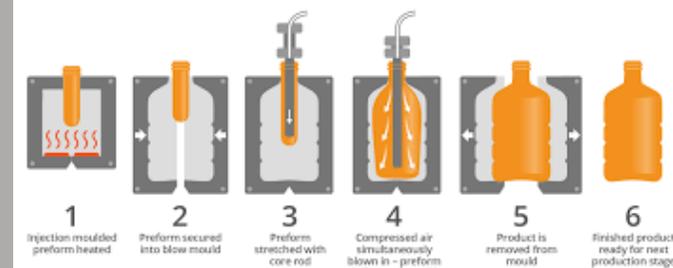


MANUFACTURING PROCESSES

Many manufacturing processes can be used when working with or forming plastic to create strong objects or products. I have listed some below

- Injection Stretch Blow Molding / Injection Blow Molding
- Injection Molding
- Extrusion-Thermoforming
- Rotational Molding
- Blown Film Extrusion
- Extrusion Blow Molding

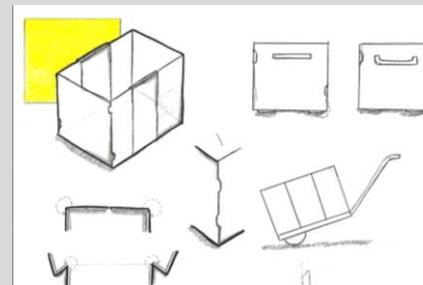
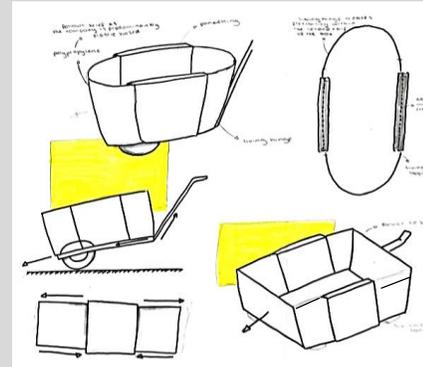
To create a quality and robust product I will use these processes to ensure that the finish product is manufactured to a high standard that will ensure a long lifespan. These processes will also offer a wider range of materials or types of plastic that can be used as it allows them to be manufactured correctly as well as using more materials it allows the processes of manufacturing to be conducted much quicker than normal.





My initial design idea was an extendable loop packaging that could be retracted and extended to suit the contents of the box. A living hinge would've been used to create maximum flexibility as well as endurance due to the nature of the use it will have. The panelling on each side of the oval will give strength while in use but also means that the packaging can be disassembled when returning to the company. I feel that this first initial design closely follows the brief that the company had directed as it can accommodate a myriad of different items and takes into account the importance of adjustability. The main body of the packaging I would make from polypropylene as it has a high flexibility and therefore will resist damage and breaking with ease, the brackets of the main body I would like to be manufactured using acrylic due to the support bit will offer to the main structure.

The oval shape of the initial packaging wouldn't be effective when being transported as it minimises packing efficiency due to the shape. I feel that cuboid would be more efficient as more of the packaging can be stacked within a lorry or shipping container which increase the number of boxes that can be shipped



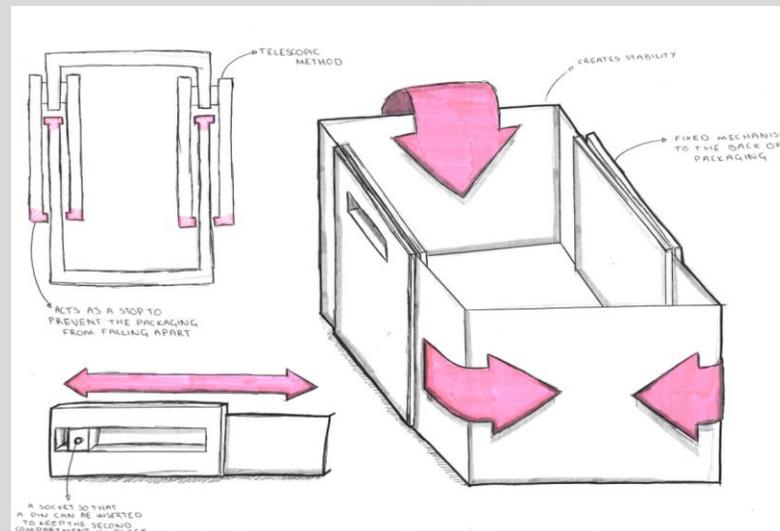
For the lid and joints of the main body of the box I have found that an overlapping dovetail joint will create a secure but also easily deconstructable mechanism. This lap joint will be on each side of each face and there will be two dovetail sections that will alternate thus connecting the sides of the box securely to prevent easy breaking and ensure its long lifespan as a reusable product. During the disassembling of the packaging so that it can be returned the joints can easily slide out of each other whilst parallel but cant be removed whilst perpendicular which stops possible breaks happening whilst being used to transport goods from the provider.

The lid for the box will be created by using sections of acrylic cut to form small mitre joints so that it can be effectively folded when opened but ensure that the lid will close securely to prevent spillages or any items falling out. The joint of the two sides of the lid will have a lip where the two sides can join securely but can be opened easily through the two rings cut out of the surface to enable an easy grip can be held on top of the box when opening the lid. As well as these handles to open the lid there will be two more handles that will allow the box to be carried comfortably

DESIGN INFLUENCE

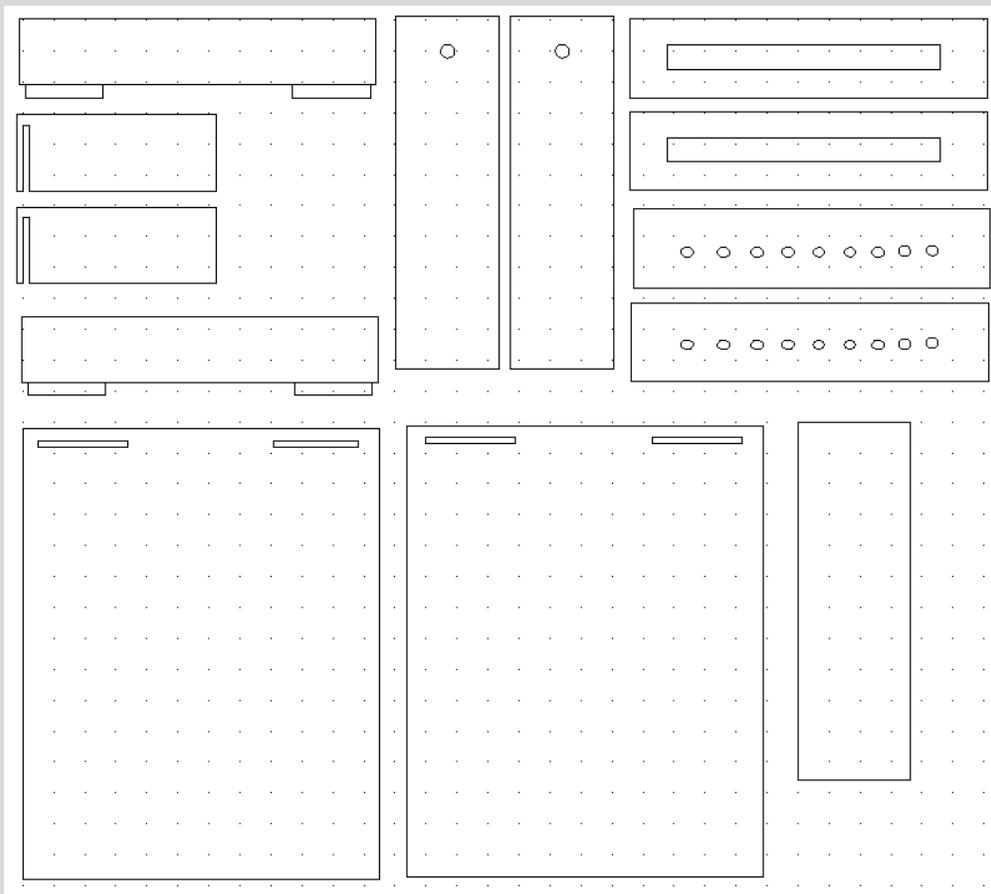
The biggest design influence that has aided me in the design of the packaging was plastic delivery crates used within large international supermarkets worldwide. They are effectively transported and stackable which increase the ease of transport of many food items. They allow these items to be transported safely and the design is very easily manufactured in many different ways. Its wide reach and usability has influenced my initial and final designs in its strength and ability to perform to a high standard whilst being accessible to many people

Another large influence within my designing processes was meal plan delivery corporations in which food is delivered in order to create meals for different families across the nation. The majority of these companies use cardboard packaging that cant be returned or reused within these corporations. This is a very rapidly growing market and I would like to focus my attention on designing packaging that can effectively and safely deliver these meals as well as be able to be disassembled so that the packaging can be returned and reused again to minimise on wastage and decrease spending which will in turn increase profits within this market



Through further iterations of the first design I have cleaned up the overall aspect of joints and how the packaging will finally be placed together and be disassembled for flat pack use. A lock and pin mechanism like that on crutches will be used within the two panels that allow the packaging to be extended to meet its contents. This mechanism will ensure that it is securely fastened in different sizes but, like a crutch, this mechanism also allows it to be completely separated from the main body so that it can be disassembled and sent back to the provider to be used again. The two panels will still be used on each side of the box but will include space for a handle as well as the mechanism that aids in the extension and compression of the final packaging.

The boxes base will be manufactured using two separate sheets that slide over each other and extend with the box to create a secure base to the packaging. The concept of having a wheel and a handle that will be used to pull the packaging along is not manufacturing or very effective in its packing efficiency as the wheels will get in the way of space that could be used for the items that will be carried inside. The handles located on both the side of the packaging and within the lid create a more effective use of space and allows for maximum packing efficiency.



This is the first initial model of my finalised design and as you can see I have introduced the mechanisms that will be used within the assembly. I manufactured this design model using a CAD software programme called 2D Design that allows you to create a net of a design or the different components that will be used. This was then transferred to a laser cutter that cut out the separate components of my design in cardboard before printing my final product in acrylic sheeting.

Initially I used cardboard to model the packaging to allow me to make changes easily and understand how my model will fit together using different materials, such as acrylic. As you can see in my cardboard model there are two mechanisms either side of the box that allow the packaging to be expanded to fit the contents that has been specified by different customers that would use this service. The mechanism that is used to expand the packaging follows the mechanisms that are used on items such as bike seats and crutches that need to be lengthened to suit different people. This allows the packaging to be used for many different customers and different contents whilst also being able to be used numerous times by the company. There is a pin that will be used to hold the packaging in the position that it needs to be extended by. This can be interchanged by the customer also.

The packaging is comprised of two separate sections that can be folded into each other to allow the packaging when finished with to be flat packed to be sent back to the company to cut down not only on plastic waste but also the cost of trying to produce this packaging at such a high rate. This will then be able to increase not only the profit of the companies that invest in this but the eco friendly outlook that they have within their company to provide the best service for their customers. Additionally the fact that the final packaging will be robust enough to be reused multiple times without its life span creates an easy service both for the company to provide and the customer to receive.

Here I have created a model of my final initial design using cad and 2D design. This is the net plan of my final packaging product. The whole design can be disassembled so that I can be sent back to the provider so that It can be used again for another customer to cut down on packaging waste and decrease profits that are used to contribute to the manufacture of this packaging.

There are numerous components that will need to be manufactured to be able to achieve a flat pack packaging as all of these component will need to be able to be disassembled so that it can be used numerous times.

The bottom of the box will be able to slide over each other so that the box can be extended without the bottom of the box breaking or falling apart as it could damage the contents of the packaging which wouldn't make it very functional.

There will be tabs to ensure that the packaging is connected properly by each component and will also allow it to be easily disassembled without damage to the main components. This will allow it to be able to be compact to ensure an easy collection when finished with so that it can be taken back to the provider.

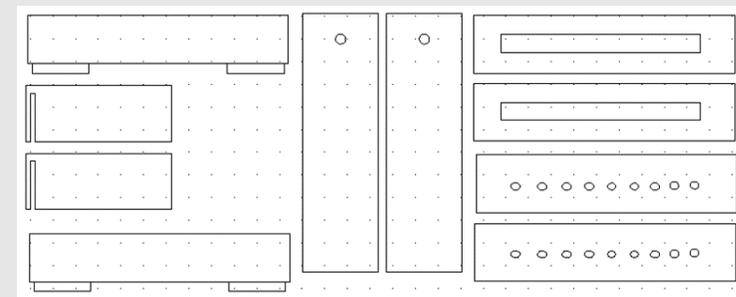
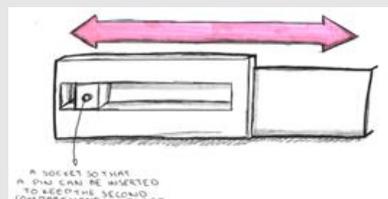
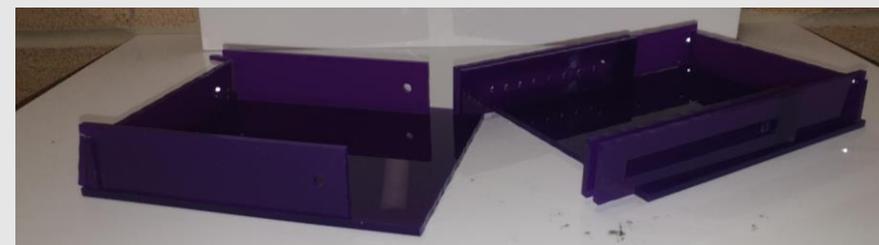


The final net of my packaging is shown below and consists of 14 individual pieces that fit together to create my final iteration model of my idea. The final design model has been manufactured to a scale model of 1cm : 2cm which allows me to explain and present my design without creating too many waste product through the use of too much material.

To create my final net of my design model I used CAD (computer added design) software to ensure that the net has been cut to the maximum accuracy to make sure that all the pieces that were needed fit together snugly to ensure the maximum strength of the packaging is provided when being transported from different locations or when being delivered to customers that use this service.

Below I have also shown the iterative development of the telescopic joint mechanism that is used in my packaging to secure the two separate components that make up the whole packaging model. Instead of a box leaver that is indicated in the initial design sketch I came up with the idea of a pin that is able to be inserted and removed as needed to keep the sections together and shorten or extend the packaging to suit the volume of the customers contents that need to be distributed.

Originally, the guides that lead part of the mechanism into each other were going to be detached from the sides but I decided to attach them together in my final design to increase the stability of the packaging as it could've easily fallen apart if not carried correctly or under immense strain. Iterative design has allowed me to adapt and correct my idea as I have travelled through the creative and manufacturing process as it encourages me to step back from my ideas and think about the logistical outcomes and purpose of the final design. Through this process I believe that I have created a suitable design model of reusable packaging that follows and fits the guidelines indicated specifically by the client that needed design input.



This my final prototype of my packaging design that will be used to help with different companies that provide a ready meal food service to customers. The packaging, as said in the previous slide, follows that same mechanical principle as extendable items which allows it to change size to suit the customers needs and wants. In the image above it shows the components that have been used in the assembly of the final packaging model and the final composition of the packaging when fitted all together. The final packaging model has been manufactured to a production scale of 1cm :2cm so that it follows the correct scale of the minimum and maximum volume that the packaging can hold.

The acrylic creates a robust structure that will allow the product to be used multiple times throughout its life span as the mechanisms on each side allow the volume of the packaging to be altered to suit the customer that is receiving the service to their home. There is space for a return address to be placed onto the packaging to either be collected when a new delivery is given or to be sent back through the post to ensure that there are plenty of these forms of packaging to supply the company and keep up with supply in demand.

Throughout the packaging's lifespan it will be able to be used multiple times to provide a service to ,many different customers. The mechanisms on each side of the packaging that allow the box to be extended to the correct volume for the customer also provide a strength to the packaging as the telescopic joint mechanism I used uses layered materials which additionally add support to the weakest sections of the packaging. Although giving strength within this proportion of the packaging it is also very easy to disassemble which allows it to be accessible to anyone that will use this particular service. For example, older people that will use this service to ensure a meal will be provided to them will be significantly weaker than some other customers that will use this service such as families and young couples. This packaging needs to be accessible to every possible type of person that could possibly use this service to provide the best experience. The packaging is easy to disassemble and lightweight to ensure that physically weaker individuals that may need help will avoid injury due to the ease of lifting and the simplistic disassembly that my final iteration of my design offers to both companies and users.