PARK UP urban furniture

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Research.



ME

Kia ora, I'm Molly Bird and I'm a third-year student studying Industrial Product Design Conjoint with Marketing. I have taken a special interest in this project as allows me to use the past three years of study in my final project through the technical and creative skills I've been learning. I tend to gravitate to human-centred design methods alongside sustainable design. I look forward to working with Ōtākaro Living Laboratory for this project and helping rejuvenate Christchurch.

PROJECT OVERVIEW

Ōtākaro Living Laboratory and Christchurch City Council are wanting to deliver an alternative approach to street furniture accessible to the general public throughout the Ōtākaro Avon River Corridor (OARC). To replace the traditional use of carbon-heavy materials such as steel with recycled plastic. To help strengthen the community with the environment

What is urban furniture?

What is the Ōtākaro Avon River Corridor?

In 1851 Christchurch City was founded via the banks of the Ōtākaro Avon River. As the city expanded neighbourhoods were established alongside the river. Ōtākaro means 'a place of play' in the Maori language. This was established through Maori children who often played when it was time to gather kai (Christchurch City Council, 2022). Was often used for recreation and boating, a common place where flounder were speared, eels, ducks, whitebait and native trout were also caught (Christchurch City Council, 2022). What once used to be a thriving place soon vanished.

Used to be a residential area, holding up to 5000 homes. However, since the 2010 and 2011 Christchurch earthquakes, damaging homes due to poor silts. Requiring the government to buy 5,442 insured property owners. Resulting in neglected parklands with communities decreased in population. The corridor is 602 hectares and 11km long. The city is ready to reclaim its land as it sees its potential to restore it. The Christchurch City Council are wanting to transform the corridor into a jewel in the Christchurch crown. In efforts to achieve this, a 337 million regeneration plan is to fund the neglected land to help the red zone reconnect to its neighbouring communities (Regenerate Christchurch Christchurch New Zealand, 2019)

"They are pieces for everybody, that we all share" - (Neko Europe, 2018)

Urban furniture is commonly associated with just park benches or litter bins. But it is larger than that. Common examples could be bike racks, bus stops, bollards, planters, seats, picnic tables, water fountains, streetlights, parasols and telephone boxes. These are items that are fixed in place and designed for everyone in a public place. Categorised in Rest, Illumination, Waste disposal, Shelter, etc, these categories require different functions to deliver the best experience to users. - (Neko Europe, 2018)



Introduction.



CLOSED LOOP

What plastic is defined as recycled?

Recycling: The process of collecting and processing materials to repurpose for multiple uses that would otherwise have been discarded for only one lifestyle. The benefit of recycling and repurposing is that it reduces the amount of waste that ends up in landfills. Prevents pollution and reduces the energy required to access the depleting raw materials. (United States Environmental Protection Agency, 2013)

Cradle to cradle: The end of the product life is recycled or upcycled, with everything recycled or returned to the earth. Through a completely safe non-toxic way. (Sherratt, 2013) Steps to close the loop to ensure a cradle-to-cradle product is produced.



CHRISTCHURCH WASTE

In Christchurch mixed recyclables curbside collection is practised. Households can only place plastics numbered 1 (PETE),2 (HDPE) and 5 (PP) into their yellow bins. Alongside glass, aluminium and cardboard. These recycled materials are delivered to the Materials Recovery Facility to sort through materials and then sent to the manufacturer to repurpose post-consumer materials. (Christchurch City Council, 2015)

For this projecct, HDPE will be the most appropriate material to use. Due to the physical properties able to hold the Ōtākaro Avon River Corridor environment, unlike PP. This material will be able to increase the product life. HDPE is commonly used for outdoor products due to its weather resistance.

Manufacturing.

1. Collection and processing (United States Environmental Protection Agency, 2013)

The four common methods of recyclable materials are deposit/refunds. Curbside collection, traditionally used source-separated recyclables.

1. Mixed waste - combination of different waste types.

2. Mixed recyclables - separated from general household waste with collection day two bins are to be collected.

3. Source separation - The highest level of involvement from households. Plastics are well sorted and reduce industries' level of sorting, decreasing production times. Requires a is separated by different melthigh level of understanding of plastics from the community. their accumulated plastics to collection facilities. However, this method works best when there are external incentives. extruders.

1. PET (Polyethylene Terephthalate)

Material is tough, strong and easy to shape, join and sterilise therefore making it a material that can be recycled. Water-resistant and durable. The material is often used in plastic drink bottles. Prone to cracking. (McCartney, 2019) Price: 1.56 - 2.12 NZD/kg (GRA-NATA)

Manufacturing methods: Additive manufacture, Thermoplastic moulding - blow moulding, compression moulding, injection moulding, polymer extrusion, rotational moulding, thermoforming (GRANTA)

CHCH WASTE

2. HDPE (High-Density Polyethylene)

Known for large tensile strength. Low density considering the large strength. Large melting point and impact resistant. Low maintenance is required therefore a large lifespan. The material is often used for milk bottles. Material resists mould and rotting. Material weather resistance is ideal for the Ōtākaro Avon River Corridor environment. Material is easy to melt and mould Can make wood plastic composites. (Acmeplastics, 2022) Price: 2.1 - 2.18 NZD/kg

Manufacturing methods: Additive manufacture, Thermoplastic moulding - blow moulding, compression moulding, expanded foam moulding, injection moulding, polymer extrusion, rotational moulding, thermoforming. (GRANTA)

2. Manufacturing (McEwing, 2015)

Due to transport, the plastic is Through shredders and granulators.

Plastic is then cleaned to reing to density. Plastic is then to separate the materials. This ing points as well as size, shape the materials into pallets for

> 5. PP (Polypropylene) flooding. Low density. sealants. (McCartney, 2019) Price: 1.73 - 1.94 NZD/kg

3. New Products

The design or redesigning of goods through recyclable materials. The use of different manufacturing processes delivers desirable goods to consumers. Encouraging consumers ing paper, glue and food. During with sustainable choices. product.

STEPS FOR CLOSED LOOP PRODUCT

High tensile strength which is good for park benches with the varied weight of users. Low water absorption for outside environment prone to

Material is affected through UV exposure. Material is hard to paint. Material is very flammable with a low melting point, and may not be safe for the park environment. Could be prevented through

Manufacturing Methods: Additive manufacture, Thermoplastic moulding - blow moulding, compression moulding, expanded foam moulding, injection moulding, polymer extrusion, rotational moulding, thermoforming.

Examples of Ōtākaro Avon River Corridor trying to restore community through use of urban furniture

Dallington Landing

In an attempt to restore the community and encourage more foot traffic Fel Street Furniture provided the Dallintong landing in the Ōtākaro Avon River Corridor. Opened in February 2022. The facility provides a public space for families and friends to gather around. With plenty of seating and tables around allowing groups to socialise and dine outlooking the river. The development also provides two public unisex toilets, one large secured rubbish bin and a railing for bikers to safely secure their bikes.

Visiting the Dallington landing on Gayhurst Road, Dallington on a sunny Friday fields putting off users, the timing of my visit may also not have been a fair repre-

Snell Place Bridge

Another attempt to restore normality to the community since the 2011 earthquakes. Christchurch City Council rebuilt 3 pedestrian bridges to 'reinstate valuable community connections, furthering the regeneration of the Ōtākaro Avon River Corridor' (Christchurch City Council, 2021). Taking a deeper look into the Snell Place bridge, located downstream being the Avon Rowing, Canterbury Rowing and Canoe Club. Located upstream is the Dallington Landing. This pedestrian bridge helps keep the communities interlinked.

The Snell Bridge is customised for both pedestrians and cyclists as has ramps for those travelling by bike. Located near the bridge is a viewing platform on either side of the bridge. This viewing platform offers sustainable wooden seating surrounded by new plantings as the development has only finished in May 2022.

During exploratory research of the environment, there were minimal users in the area. The bypassers used the space for mostly exercise and leisure. Consisted of cyclists for exercise and a mode of transport. People were using the pathway as their routinely running track. Families and friends go for a leisurely walk as they walk their dogs.

Regeneration Plan

6

The intended activities and particulars of the proposal must facilitate regeneration by improving the environmental, economic, social and cultural wellbeing, and resilience of communities.(Christchurch City Council, 2021)

Environment.

Dallington Landing with park bench. Bike racks avaliable.



Snell Place Bridge with park bench viewing the Avon. Made with natural materials suitable for 1-3 users

Why is there a need for urban furniture?

required much thought.

- Increasing (foot) traffic flow
- Benches and seating areas encourage socialising Create a sense of community.

- ment
- tidy (bins)
- reducing pollution
- Well-kept and maintained furniture gives the people the security of being in a safe environment

Policy & Standards ager & Samson, 2003

- There are many benefits to adding urban furniture to the community. Beautifying the desperate Ōtākaro Avon River Corridor landscape that is in needs to be livened up. A well-kept appearance can help improve health, reduce crime, social bonding and even better academic performance for children (Wood, 2015)
- The reasoning behind the implementation of urban furniture in public areas wasn't just an afterthought. The impact of urban furniture has a significance that has
- Ways urban furniture benefits the area:
- Enhancing the quality of life
- Encourage and connect users with the environ-

Helps keep the area and environment clean and

Bike racks, encouraging the use of clean transport

Since November 2002 Rubish-free Parks initiative has been implemented in parks all over Christchurch. The drive for this initiative is to force people's awareness of waste and encourage the community to reduce, reuse and recycle. This resulted in many parks having rubbish bins removed. Overall this benefits the community by reducing problems associated with waste such as smell, rats, hygiene and visual impacts of parks. (Man-

Who:

The target user is the general Christchurch public. As designed for a public space in Christchurch where people of all ages and abilities come to the area for various purposes. The range of users needs to be taken into consideration as Christchurch is a diverse community. It is important to understand the users' interaction with the OARC area. Therefore, for a deeper understanding, a survey was posted to local Facebook community pages neighbouring the OARC.

Survey Results Summary:

Jser

43.8% of respondents belong in the 46-55 year age bracket.

50% of respondents tend to visit the area **3+ times a week**

Most of the respondents claimed they visit certain areas of the corridor due to being near their homes. The minority was due to parking and disability access.

The biggest interest in the type of urban furniture respondents would like to see in the OARC is a blend in design that caters for **3+ users**.

A large number of respondents visit the area with family or walking their pets.

This information helps highlight what the space is used for and how to cater for the general publics interest and activities. Key take aways from the survey results is to ensure design blends into the environment, design considers users with pets and people with mobility issues.

Further comments from anonymous respondents:

be made from natural materials.'

'While I applaud the recycling of plastic, I wouldn't like to see anything plastic or manufactured in the OARC. It should be a place of connecting with nature

From the survey is it obvious that people support sustainability and recycling. However, they prioritise the ambience of OARC and believe that the use of plastic will hinder it. In my concepts will need to ensure there is a balance of recycled plastic and natural products to ensure the design fits the environment.

Results may be biased, as respondents tend to be of a certain age bracket as they tend to want more from their community rather than younger generations. The lack of younger respondents may impact the accuracy of the surveyarea becoming difficult to access.

> Survey questions can be found on QR code



ridor





The results shown here, helps highlight the broad range of activities the space is used for. These activities will need to be considered when designing the product. As if done correctly the user interaction with the space can increase which will help achieve the goal of restoring the community.

What type of urban furniture would you like to see more of along the Ōtākaro Avon River? Cor-



What's the reason for visiting the Ōtākaro Avon River Corridor?



For the design to be suitable for the users, ergonomics need to be considered. With the design available for the general public, the seating needs to be suitable for a range of user sizes. Ergonomics has a relationship with comfort, when achieved the design will have longer interaction with users. Having a greater interaction with users will help revitalise the area as will increase the number of users in the area. Achieving the project problem. Without this research the design may not be appropriate for the community.

To accommodate for the population, the 5th percentile female to 95th percentile male will be beneficial to a large portion of the public (Openshaw, & Taylor, 2006).

Wheel chairs:

Due to the space being designed for the public. It is important to design for users of all abilities. Therefore, consideration of wheelchair users will need to be required. The design needs to accommodate users through consideration of table height and extra turning pace for users (Openshaw, & Taylor, 2006).

	Measurement	Letter	Female cm 5th - 95th%	Male cm 5th - 95th%	Overall Range
T (Sitting Height	А	79.5 - 90.9	85.3 - 97.3	79.5 - 97.3
194	Sitting Eye Height	В	108.2 - 123.9	117.6 - 133.6	108.2 - 133.6
	Waist Depth	С	18.5 - 27.2	19.8 - 29	18.5 - 29
	Thigh Clearance	D	53.3 - 62.2	58.4 - 68.1	53.3 - 68.1
	Buttock-to-Knee	E	54.2 - 64	56.9 - 66.8	54.2 - 66.8
C	Knee Height	F	42.9 - 58.9	54.4 - 63.5	42.9 - 63.5
E L	Seat Length/Depth	G	42.9 - 51.9	44.9 - 53.6	42.9 - 53.6
10	Popliteal Height	Н	38.1- 47	42.4 - 50.5	38.1- 50.5
	Seat Width	Not Shown	36.8 - 45.7	35.1 - 43.7	35.1 - 45.7



Measurem
Desk Depth
Lower Reach Height (min)
Desk Height
Shelf Height (r

Good universal design practices suggest for park benches (David, 2020):Sitting ergonomics1.2 - 1.8 m range in seating length

Seat height should be 40 - 50 cm above the ground 75 cm - 120 cm ground space at end of bench for wheelchair users. Installation should be on stable even ground

Back rests are intended to extend seating interaction due to higher comfort Backless benches are used for brief stops

Literature Review

(Openshaw, & Taylor,

2006).

Ergonomics was researched to help find dimensions for the most suitable dimensions for the general Christchurch public. Openshaw, & Taylorstudies the ergonomics creating a design guide. It was suggested to use 5th female percentile to 95th percentile male to accommodate for the large proportion. Therefore having the seat width range being 40-50 cm is further confirmed through a different article, A Guide to Park Benches. Which says average park benches for 3+ user range for 12 - 1.8 m. This is further confirmed with the study saying the popliteal height to be 38-48 cm where the article says the seat height being 40-50 cm. Therefore, using the 5th female percentile to 95th percentile male will be suitable for public spaces.

Ergonomics.

8

Wheel Chair ergonomics (Openshaw, & Taylor, 2006).

nt	Letter	Value cm
	А	50.8 - 63.5
	В	22.9
	С	68.6 - 86.4
nax)	D	121.9

Materials on the market and their elements (David, 2020):

Wood

Natural aesthetic, will blend within the Ōtākaro Avon River Corridor natural environment. Commonly seen in park benches with a combination of metal. Finishing of the wood provides protection and level of customisation. Requires a certain level of maintenance with UV and weather resistant sealants to ensure the wood remains attractive. Will not last decades compared to other materials. Wood provides a level of comfort compared to other hard materials. Weight is significant however will need to be fixed to avoid theft.

Metal

Metal used in benches are often used for structure and fixings. The project is wishing to limit the overall use of metal due to carbon heavy emissions. However this material is often used due to the long lasting and low maintenance with possible refinishing if paint scratched off. The comfort is variable however the heat transmits making it cold or hot to sit on.

Plastic

Plastic is offered in many different materials. The most common is seen as a wood plastic composite to gain a natural aesthetic with the use of recycled plastic. These are UV and wear resistant. Durability varies on the material type. Thin material may have deformities due to heat and wear. Comfort is the same with wood however it may get warmer in the sun. Weight of plastic benches is light therefore will need to be fixed.

Concrete

Very modern aesthetic, very solid forms. Concrete is more durable and lasts for decades. Ability to store heat may be uncomfortable in the sun. large weight, no fixing will be required to avoid theft.





Metal park seat (Pricepulse, 2022)





Wood park seat (Cannon, 2017)



Recycled Plastic Urban Furniture

In 2016, a company called **Print Your City** was first established in Amsterdam. Print Your City transforms plastic waste into upcycled urban furniture through the use of 3D printing. Consumers can recycle their plastic waste with the ability to customise and design their product to repurpose closing the waste loop. The company thinks about the environmental impacts as well as the usability. (Print Your City, 2016) **XXX Bench:**

Product uses over 50 kgs of recycled plastic waste which saves over 125 kg of CO2. The company makes urban furniture that is suitable for 1-2 users 150 cm long by 80 wide.

The ability to customise the product can adapt for different environments, such as a dog bowl or bike rack attached to the design.

Price is unable to be found, however believes this method would be more costly due to long manufacturing hours and new technology.

Interesting shapes

Pros:

Reduce carbon emissions Uses large amounts of recycled plastic 3D printing provides shapes other manufacturing processes can't do Overseas competitor

MIX URBAIN

MP French company, MP Industries works closely with Mix Urbain to offer outdoor furniture and equipment with the use of recycled HDPE. The company offers multiple product lines and selections. However, with the large range the products offered are designed for functionality and designed to blend in. The designs are traditional, this shows that with non traditional materials the outcome is still achieved. This company tries to intimidate natural materials. Pricing is unable to be found.(Mix Urbain, 2020) **Antenna Banc**

Back rest Blend in aesthetic 1700 mm long Multiple colour options

Pros:

Household plastic Overseas competitor Large range **Cons:** Cheap/ poor quality aesthetic



XXX Bemch made from recycled plastic by 3D printer (Rinaldi, 2017)



Antenna Banc Bench made from recycled HDPE

Market.

Cons



AIM

Enhance local Christchurch users' experience at the Ōtākaro Avon River Corridor by delivering up to 1000 units of park benches for 1-3 users made from recycled HDPE to increase the livelihood of the communities.

Brief:

Christchurch City Council and Ōtākaro Living Laboratory wanting to regenerate the livelihood of the Ōtākaro Avon River Corridor (OARC) that is now missing since the 2011 earthquakes. Offering more public spaces will help increase users interaction with the space, through the use of a park bench in the Ōtākaro Avon River Corridor (OARC) that accommodates for 1-3 users. The design is made from household HDPE recycling to close the loop of product life.

Objectives:

1()

- Explore competitors in the market by week 3 to understand the potential strengths and weaknesses
- Explore and have deep understanding of user's interaction with the Otākaro Avon River Corridor by week 3
- Explored and researched appropriate materials structurally and environmentally appropriate for the design by week 6
- Résearched Christchurch City Council policies and regulations by week 6
- Research and analyse target user and market by week 6
- Finalise PDS and brief by week 6
- Deep understanding of the Ōtākaro Avon River Corridor environment including future developments by week
- Generate and evaluate multiple appropriate concepts by week 7.
- Continue exploration through the use of prototyping and model making by week 12
- Refine final concept based on final manufacture and material decisions before starting CAD model week 12
- Evaluate market and user suitability of chosen design against initial research findings and PDS week 11
- Complete all material for hand-in by the end of week 12

Aim + Brief + Objectives.



Product:

The design must provide seating for 1-3 Christchurch public users

Through a survey, 68% of respondents would like seating for 3+ alongside 37.5% also voted for individual seating.

The design must be 50 cm-1.8 m in seat width.

This complies with Ergonomics and Design A Reference Guide which fits 1-3 users which is confirmed by a supporting article, A Guide to Park Benches.

The popliteal height should be 40-50 cm above the ground.

Comfortable seat height confirmed by the Ergonomics and Design A Reference Guide and A Guide to Park Benches.

The design must have 75 - 120 cm clear grounding available at the end for wheelchair users

This was suggested through the research from Ergonomics and Design A Reference Guide and A Guide to Park Benches.

The design must consider the use of a backrest to increase the length of interaction with the area by 15 minutes

A Guide to Park Benches explains that the use of backrests is intended for people to rest for a longer period.

STANDARDS:

The design must comply with the Ōtākaro Avon River Corridor Regeneration Plan.

A regeneration plan has been placed to revitalise the OARC. It's important to comply as the plan is at a larger scale than this project.

They must facilitate regeneration by improving the environmental, economic, social and cultural wellbeing, and resilience of communities.

The Christchurch city council will support the design if provides public benefit, as the aim of the project is to bring the local communities together

User Friendly:

The design must be suitable for the active Christchurch public community aged 3+.

This is due to 31.3% of respondents stating they visit the OARC with their families

The design must be all-ability accessible and friendly by following Ergonomics and Design A Reference Guide

This is to ensure that the space can be utilised by the greater portion of the public.

The design must consider the different activities users do within the environment (dog walking/ cycling)

Through the survey, respondents more than 50% stated they go to OARC for exercise. With 31.3% accompanied by pets. OARC is a place with various activities that need to consider.

The design must consider the ergonomics of users from the 5th percentile female -95th percentile male given through Ergonomics and Design A Reference Guide

Due to being designed for the general public, ergonomics over a range of sizes need to represent the range of the public.

Manufacturing:

The design manufacturing process must be able to produce 1000 HDPE product units throughout the OARC. Ōtākaro Living Laboratory and CHCH City council are wanting to produce many units alongside the OARC. manufacturing process needs to be feasible.

The design will consider the use of natural materials in conjunction with HDPE

Respondents of the survey expressed concern for the use of recycled plastic in the OARC would ruin the natural ambience.

The design must be placed on even and suitable ground of 180 degrees.

For appropriate construction, the bench should be on a flat even surface to enhance product life. The design must be suitable for the OARC climate for up to 15 years before maintenance.

OARC climate is prone to flooding as well as UV exposure, therefore HDPE is appropriate.

Aesthetics:

The design must blend in with the OARC environment through the use of natural materials.

75% of respondents said they would like to see a blend in design with the environment. To create balance, use of natural materials can be used instead of traditional metal materials.

The design must consider modular seating designs for 1-3 users

31.3% of respondents said they would like to see more modular seating designs.

Material Requirements:

The design must incorporate recycled household plastic HDPE to reduce the use of carbon-heavy materials

HDPE is one of three recycled plastic materials collected in Christchurch. HDPE is the most suitable for this environment due to weather resistance, impact resistance and long product lif

The design will consider the use of natural materials in conjunction with HDPE

Respondents of the survey expressed concern for the use of recycled plastic in the OARC would ruin the natural ambience.

The design must consider a closed loop design

Recycled plastic must be continuously in the loop to be more sustainable, rather than use steel.

The design must be suitable for the Ōtākaro Avon River Corridor climate for up to 15 years before maintenance.

OARC climate is prone to flooding as well as UV exposure, therefore HDPE is appropriate.



Discovery

Brainstorming Project plan User research Environmental research Market research Material Research Manufacturing Research Brief + PDS

Design

Initial Ideas Concept Generation Concept Selection Prototyping Concept evaluation

Deliver

Material selection Manufacturing selection Concept Refinement CAD Design Poster



For this project, the chosen IDEO Human centred design is most appropriate. As the design is for the general public of Christchurch. The continuous diverging and converging allows us to make the most appropriate design solution. This approach has three key stages. Discover, Design, and Deliver. At first, several solutions are available by research we identify the users' needs to prioritise our design solution. Through design, we are able to further explore solutions to achieve our final design

Design Methodology.

Discovery:

Diverge the projects potential. First by exploring all aspects of the project. This is found by several layers of research that all interconnect. From the research we are able to identify problems and solutions creating our PDS. These can be implemented into our design phase.

Design:

Converging all the research and findings from the discovery phase we are then able to focus on the solutions. As we generate ideas we continuously converge and diverge to ensure we explore all available options. SCAMPER can be used on final concepts to open up ideas.

Deliver:

Converge all concepts available to determine the chosen concept through a controlled convergence matrix. Manufacturing and materials will be finalised to make the product feasible. By the end delivering a well refined product that will be ready for the market.



Boarded cells seen on the Gantt chart are the reality of the progress of the project. The highlighted cells are the original project plan timeline. The Gantt chart wasn't followed closely. This may be due to fixating my time on environment research. As well as brainstorming for 3 weeks to ensure all aspects of the environment were considered due to the project broadness.

Although an important element to research, 5 weeks into environmental research is far too long. More time should have been focused on the ideation pages. As although research is important it is also important to be able to communicate how your research through your ideation pages. Because of the time spent on the research, ideation pages were unable to be fully explored due to time limits. Because of this In the following weeks more sketches are required to fully explore possible ideas.

Another adjustment moving forward would be focusing on key elements in the research. As this project was very broad, therefore having multiple research directions. Resulting in not having as deep of an understanding in greas as would like to.

However, I beleive I have a deep understanding on the users through use of surey and environmental research. This is impoartant as this project is focused on human centred design. Benefit to having a large scope of research enables me to make educated decisions through the project. Moving forward it is important to strictly stick to the period allocations. As the period has a domino effect. This will allow each step the correct allocated time. This will be important on concept generation.

I am hapy with the broadness of the research as helps me diverge with my ideas. Throughout the project research will continue to create accuracy in the feasibilty. This may be done through researching key elements that are important in my project. More manufacturing research will be needed once manufacturing technique is selected.



ensure that each step is considered through timeline naviaates the design process through each step. Highlighting the four key areas in the project. Discover, Design, Implement and Deliver.

Ideation.

Mindmap.

Mind Map

Used to help highlight the various elements considered in this design. This helps show the connections between each element. In the ideation it will be beneficial to combine the key elements to deliver the most appropriate concept for this project. The three key areas to focus on in ideation is the material waste component, user interaction component and the urban furniture itself.

Moodboard.

Mood Boards is used to help highlight the key features and forms found in Christchurch. This will be used as inspiration to incorporate ideation concepts. Having a mood board of Christchurch will help the OARC connect with the rest of the city, which will be achieving the project objective. These images contains Christchurch history as well as the city's hotspots.

(ArchDaily, 2017)

(Rowa, 2011)

(Christchurch City Council Libraries, 2022)

(Hotel 115, 2016)

(Colin, 2019)

Ideation.

(Hooft, n.d.)

These forms are inspired by the repeating units commonly seen throughout Christchurch

> The long rope like forms are inspired by the tramway trail tracks founds al over the Christchurch Cit centre.

Muliple repeating units to make up a form allows more customisation to each area. This layout provides spacing for wheelchair users.

These long forms could be explored through 3D printing. More research will need to be required

Prototyping.

Playdough is used to help communicate ideation concepts in clear 3D forms. This rapid prototyping method shows overall forms as well as the feasibility of the design. Playdough provides a large level of customisation which is a representation of the HDPE material that will be used in this project. As HDPE manufacturing processes are capable of unique forms, unlike traditional materials. The choice to begin ideation through playdough is due to the rapidness, generating many forms, opening up the creative flow, and diverging the ideas.

Moodboard.

This mood board is of the organic matter found within Christchurch and alongside the Avon river. This was important as found in user research, respondents wanted the design to fit into its environment. Incorporating surrounding forms can help achieve that.

(Ōtākaro Limited, 2021)

(Shutterstock, 2022)

(100% Pure New Zealand, 2022)

(Christchurch City Council, 2016)

(NZ Pocket Guide, 2017)

Ideation.

(Spiers, 2013)

Side view of concept, extended back to act as a table for users to use as a lunch spot. However, will be standing.

FAST Technique.

Function analysis and system technique (FAST) is a method used to help highlight the key functions and elements required for urban furniture. Prioritising the prime function and then building from that through the use of basic and subfunctions to enhance users' experiences to help increase the interaction of the design space. This method helps us understand why and how users interact with the product and their motivations to use it.

FAST technique is completed by the following steps:

Function tree

This helps understand the level of importance of each design aspect. Meeting the prime function is important and then how to deliver and enhance the prime function through the use of basic and sub-functions.

Morphological Chart

Helps give a clear understanding of how different functions can be achieved. Through various options created.

Evaluate

This is achieved by comparing and evaluating the concepts. This will highlight the strengths and weaknesses of the concepts and how we can enhance the design to suit the brief best.

For the design of the urban furniture, a function tree is formed. Highlighting the prime functions followed by the basic functions and sub-functions. The prime function is to provide seating as users tend to want to sit when settled at one location for a certain period of time. The basic functions are focusing on the key aspects the prime function re-

Sub Functions	Option 1	Option 2	Option 3	Option 4
Environment	Shelter	Look out view	Prevents water build up	Wind br
All Ability Users	Various seat sizes	Backrests	Armrests	Play are small kid
Exercise	Bike Rack	Dog Bowl/ Dog Leads	Escooter	Shoe cle
Leisure	Comfort	Table for eating	Community Garden	Foot Res

From the functions provided from the function tree of urban seating. We can create a morphological chart. This creates viable options and solutions to suit the key functions. This chart allows for the creation of multiple different combinations that can be adapted into the design. This helps diverge the ideation process by broadening the scope by considering many key aspects of the project. From the combinations, this can be the starting point to generate appropriate concepts in ideation.

Environment:

This focuses on the OARC climate and location. The design needs to be appropriate for all weather conditions. A water drainage system will need to be considered to avoid water pooling on the design as it will discourage the use of the product.

All Ability Users:

After user research, various users visit the space. Key user considerations are people with mobility issues and families. Having extra support through back rests and arm rests will help encourage the use of the space as well as extend the interaction with the design.

Excercise:

Through user research, the majority of people use the space for exercise. Form of exercise is walking the dog, cycling down the Avon and going for a routine run. These activities should help inspire the design.

Leisure:

People also use the space for a pastime activity. A survey respondent also commented on community gardens. This could be adapted into the design. This location is also used as a popular lunch spot, so a table could be considered to help enhance the user's experience.

Morphological Chart.

4

eaker

a for ds

eaner

st

Avon River inspired

form

Highlighted wooden seating to add balance

Built in garden patch

Bike rack at end of seat

Two seats at different heights for families and people with mobility issues

Sub Functions	Option 1	Option 2	Option 3	Option 4			\nearrow
Environment	Shelter	Look out view	Prevents water build up	Wind break	er	A	\downarrow
All Ability Users	Various seat sizes	Backrests	Armrests	Play area fa small kids	r		
Exercise	Bike Rack	Dog Bowl/ Dog Leads	Escooter	Shoe clean	er		
Leisure	Comfort	Table for eating	Community Garden	Foot Rest			
snoc the 2	k wave recorded 011 earthquakes	The d sheet in var	esign made ou HDPE that is s iation.	ut of stacked			
shoc the 2	k wave recorded 011 earthquakes	The d sheet in var	esign made ou HDPE that is s iation.	ut of tacked			
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shoc the 2	k wave recorded 011 earthquakes 0 at shock	from The d sheet in var	esign made ou HDPE that is s iation. DDDDD Largest sha a wind brea	ut of stacked O ock wave acts oker	Design p shade, s tion.	rovides para	tial protec-

n has a built in dog where owners can their drink bottle in eir dogs to drink

> Design has shelter from the sun or wind. However, the design still allows users to see its surroundings through the spaced out design.

Smooth form, inspired by flow of the river.

Concepts.

The corridor spans over 11km across Christchurch. With this the OARC has more established hot spots with larger foot traffic. Therefore this design can adapt to the environment by providing more units for the popular areas. With the more quieter areas decreasing the number of units. This will provide consistency throughout the corridor and helps highlight the hotspots.

CONCEPT ONE.

MANUFACTURING.

Concept 1 is rotation moulded through HDPE powder that is heated up when in rotation moulded to form an enclosed hollow cavity.

The assembly of the units will require water to be accessible to have the units secure in place. If not sufficient then other methods would need to be explored. Transportation will be considered if assembled before. The glue will need 24 hours to bond, is that enough time to avoid vandalism. Will need to consider the ground, will weeding be a problem?

X-section of rod slotted through two separate units to ensure units are and vandalism purposes, rod

insert open to allow water

(lose up view of the two threaded rods threaded into the

The corridor spans over 11km across Christchurch. With this the OARC has more established hot spots with larger foot traffic. Therefore this design can adapt to the environment by providing more units for the popular areas. With the more quieter areas decreasing the number of units. This will provide consistency throughout the corridor and helps highlight the hotspots.

CONCEPT TWO.

The base will be injection moulded. To provide the cut out for the leaf as well

The stem is formed from rotation moulding. This will provide a hollow form with

For the assembly of the seat the foundations will be on a small concrete slab. This

may not be too weak. Which could cause a wobbly and not secure seat single only

The corridor spans over 11km across Christchurch. With this the OARC has more established hot spots with larger foot traffic. Therefore this design can adapt to the environment by providing more units for the popular areas. With the more quieter areas decreasing the number of units. This will provide consistency throughout the corridor and helps highlight the hotspots.

CONCEPT THREE

MANUFACTURING.

Concept three is formed by recycled HDPE that is rotation moulded to create balance the design is also with maple wood. Maple is used due to the affordability and durability of the wood. However design can be entirely recycled HDPE. Replacing the wood with recycled HDPE the mimics wood. The wood would need to be milled

The HDPE will need to have cut outs to allow the bolts to attach to the wood. The wood will need to be sanded, treated and stained to help protect the material. This will help increase the product life of the material as well as delivering a finished look.

For the assembly of the design. The recycled HDPE will fit into the wood panels. Bolts/ screws will be drilled into both components to have a completed structure.

If the wood is replaced, the design may not be heavy enough to avoid vandalism. Fixing will need to be further considered. The foundations need to be considered

The smaller units may need to be fixed as will not be heavy enough.

more established hot spots with larger foot traffic. Therefore this design can throughout the corridor and helps highlight the hotspots.

CONCEPT FOUR.

MANUFACTURING.

Concept four is formed through 3 recycled HDPE components. The leaf is rotation moulded giving a hollow leaf structure. The seat of the design will also be rotation moulded. With the base being injection moulded. All components will have threads for the component to join together to become a singular unit.

For the assembly of the unit, the foundation will require a small concrete slab in the ground. This will help ground the unit as the base will be bolted onto the concrete slab. The leaf has threads that are threaded on to the seat. This seat is then threaded on the base. For security against vandals, epoxy resin is added to the threaded to strengthen the attachment. Welding of the plastic is also viable if necessary.

appropriate strength to the design for the general public. The design is made of three individual components, which will affect the overall cost of the design as will require complex moulds. However, this design can add different forms of the design rather than one leaf design e.g. flowers. Because of the use of epoxy resin, the repair of one damaged unit may not be achievable.

30

Using recycled materials is an important aspect of this project. Therefore, communicating that the design is made from recycled materials to the users helps enhance the product. It is important for the user to gain an understanding of the product as it will help increase the awareness of recycling materials. As seen in the survey, many have reservations about the use of plastic in the park setting. However, showcasing how recycled plastics can be used will be beneficial.

This can be seen here by creating a variety of surface finishes to show the 'raw' material. This can be by having 20 and 560 RA (Rough Average).

Another way to communicate to the users is using old fishing nets. As this is made from recycled HDPE. The design can be 'caught' in the fishing net, to help communicate a deeper meaning. A key issue for this is this may fray and spread micro plastics in the park.

Another way to communicate that the product is made from recycled material is using the raw colours when using raw materials. Creating a mix of colours to visually see the design is made from a variety of old

products.

Concept Evaluation.

Controlled convergence matrix is a systematic method for comparing concepts against the PDS. This is used to eliminate bias on certain concepts. The datum used is Antenna Banc Bench made from recycled HDPE. This is selected as offering the same material properties with this project as well as having the form of a traditional park bench commonly seen. Basing the designs against this concept will give the results highlighting concepts strengths and weaknesses. The weighting of the criteria is altered for the level of importance. Note: Client preference is a key criteria, however, clients were unresponsive.

Controlled convergence matrix is a systematic method for comparing concepts against the PDS. This is used to eliminate bias on certain concepts. The datum used is Kaypark Recycled Plastic Park Bench. This is selected as offering the same material properties with this project as well as having the form of a traditional park bench commonly seen. Basing the designs against this concept will give the results highlighting concepts strengths and weaknesses. The weighting of the criteria is altered for the level of importance. Note: Client preference is a key criteria, however, clients were unresponsive.

Symbols used in the matric as (S) for meeting the same criteria as the datum, (-) for meeting the criteria less than the datum and lastly (+) for exceeding the criteria against the datum.

The chosen concept will the highest overall total as will be the concept that aligns the most with the PDS.

Four concepts are chosen to give a selection of different directions, with different strengths and weaknesses

Concept 1:

This seamless butterfly-like design is made to be personalised for the area. This design offers different placement, arrangement and heights. This is designed to adjust to the given location.

Concept 2:

This leaf-like design provides individual seating upon a leaf. This design also provides a dog water bowl in a small lead. This concept is offered in various sizes to accommodate children.

Concept 3:

This contemporary design provides a balance of material of natural and recycled plastic. The design is made of many repeating units, this can be adjusted for the location placement. The design also offered a bike rack.

Concept 4:

This leaf inspired design provides individual seating. The design also provides shelter for users from the weather. Depending on the location, many units can be found in one area.

Datum:

The datum provides the traditional shape often seen in parks. This bench is made from recycled plastic that looks like traditional materials.

Controlled Convergence Matrix.

Concept one

Concept three

Datum (Kaypark, 2022)

Concept two

Concept four

Key Criterio	Weight	Dotum	Concept One	Concept Two	Concept Thre
Client Preference	5		N/A	N/A	N/A
1-3 Users	2		+	S	+
Ergonomics for children	1		S	+	S
Ergonomics for Adults	3		S	S	S
Suitable for all weather	4		S	+	S
Suitable for Mass Production	3		+	-	+
Blend in Aesthetic	2		-	-	S
Standout aesthetic	2		+	+	-
All Abilities	1		S	S	S

Controlled Convergence Matrix.

S
S
S
+
-
-
+
S

N/A

Key Criteria	Weight	Dotum	Concept One	Concept Two	Concept Three	Concept Four
Recycled Materials	3		S	S	S	S
Storyline	2		+	+	_	+
Natural Materials	2		S	S	+	S
Modular Design	2		+	S	+	S
	Total (-)		2	5	4	5
	Total (+)		11	9	9	8
	Total (s)		14	13	14	14
	Overall total		+9	4	5	3

Controlled Convergence Matrix.

1. Concept One

The best concept has 11 advantages against the datum. The concepts strengths are the design is suitable for mass production as it will be rotational moulded. The other strength is that the design can cater for a numerous number of people. The modular design and aesthetic has a bigger advantage than the datum and other concepts. The concept is the same for the datum for ergonomics. The design is made to be seen therefore the design stands out more than the datum. Main disadvantage is the design doesn't cater for children ergonomics. Scoring an overall of +9.

2. Concept Three

Concept was the second best concept against the datum and criteria. With 9 advantages, the design is suitable for mass production as made of multiple repeating units. The design provides the balance of plastic and natural materials. There were 4 negatives with this design and this design lacks character/ storyline/ stands out. Scoring an overall of +5.

3. Concept Two

Concept two has a total of 9 advantages with its key strengths being ergonomic for children as it comes in a variety of sizes. However the main disadvantage is the complex geometry makes the manufacturing more difficult and costly, therefore not suitable for mass production. Scoring an overall +4.

4. Concept Four

The last concept that fits the worst against the datum and PDS is concept four. The key strengths being the novelty design with a built in shelter making it suitable for the weather. Because of the novelty design, this makes the assembly and manufacturing difficult and higher costs. Overall scoring a +3.

Going forward. will continue with concept one due to the position in the controlled convergence matrix. With the disadvantages highlighting that the concept doesn't cater for children. Moving forward aspects of other designs may be considered to deliver the best final concept.

Matrix Evaluation.

Concept Refinement.

This dining chair provides users with a very 90-degree upright posture. Through the use of flat surfaces and smaller seat depth and width. This ensures the user has no room to lounge in the chair. To adapt this in the design, the concepts will use the in-between of these two chairs. As the seating will need to provide structure but also comfortability

The overall sizing for the component will be 1500 mm long. This will provide comfortable seating for 3 users for the unit to provide for 95th% of the public. The height of the component will be 450mm which will provide a comfortable seat height for the public. However this dimension does not provide a comfortable seat for children. Therefore, further consideration on how to provide for families may need to be considered. For ease of manufacturing, all units will be the same size to be able to mass produce and low costs.

Sizing Ergonomics.

ent	Letter	Female cm 5th - 95th%	Male cm 5th - 95th%	Overall Range
	A	79.5 - 90.9	85.3 - 97.3	79.5 - 97.3
ight	В	108.2 - 123.9	117.6 - 133.6	108.2 - 133.6
	С	18.5 - 27.2	19.8 - 29	18.5 - 29
nce	D	53.3 - 62.2	58.4 - 68.1	53.3 - 68.1
ee	E	54.2 - 64	56.9 - 66.8	54.2 - 66.8
	F	42.9 - 58.9	54.4 - 63.5	42.9 - 63.5
Depth	G	42.9 - 51.9	44.9 - 53.6	42.9 - 53.6
ht	H	38.1-47	42.4 - 50.5	38.1- 50.5
	Not Shown	36.8 - 45.7	35.1 - 43.7	35.1 - 45.7

Drignal CAD model. This helped highlight that the dimensionng for the design is too large as this image gives an overall ength of 3000m which is too excessive.

Final CAD design. Full assembly of the rebars, plastic caps and overall hollow form. With the dimensions being smaller than nitial concept. 1000mm long and 235mm tall. Seat depth has remained the same. 12 holes avaliable for rebars to be arranged to designed arrangement. Only 8 rebars are used in this image.

Solidworks is used as a method to help model the design. This helps highlight the technicalities of the design.

After Using CAD to model up the design, the sizing was highlighted that the component is too large. As if there were many units together with a length of 1500mm the assembled product of many units would be too large for the amount of use the units will actually get used. Although the aim for the project is to encourage more use of the area, this would be too excessive. Therefore, the change in length is 1000mm.

After the controlled convergence matrix, a key issue for the design is the ergonomics is not child friendly. To accommodate this flaw, the height of the seat has been altered from 450mm to 235mm. Because of this, to be functional for adults, stacking of two components will be required. This will allow other functions such as exercise and playing on the seats by creating volume.

Another alteration made in the CAD is that the hole/plug to allow the water into the hollow component has been removed. The use of water was originally to help fix the units and prevent theft. However, this will be unnecessary as the component will have reinforcement bars fixed vertically into concrete that the part will be slotted into and glued into place with epoxy. The use of water may cause greater negative implications to the design.

For the extra strength of the component, kiss offs are located at either end of the design. This is to ensure the product has a long product life for general public use.

CAD Model of the plug to allow the water to be inserteed to make the component heavier. Holes also for the rebars to be slotted through. After further consideration, the plug whole will be removed as the rebars will be secure enough for the design.

finish. This will create ease of manufacturing.

CAD Refinement.

Close up of the rebar holes avaliable to provide different d rangements. Soft radius is applied to create a seamless srooth

Scaled man sitting at the end of unit facing inwards.

Top view of scaled man sitting at the end of unit facing inwards.

Scaled model of two units place on top of each other.

Prototype.

To get an understanding of the size and dimensioning of the component compared to the typical users. A 3D printed scaled model was made. The decision to use 3D printing was mensions which allows us to import the CAD to 3D prints. Creating a scaled model would be costly on time and resources. Only one unit was printed as was to be used for size reference. To gain an understanding of the scale, a scaled average sized man was also printed to see how the users interact with the product and how the design fits the average person. The prototypes are printed at 10% of the scale due to 3D printing limitations.

Prototyping the final concept was used to validate the determined dimensioning. The results of the scaled prototype were that the components fit nicely. The height of the unit is at a comfortable height of 2 x 235 mm. This will be too large for children however height of one component will be appropriate for young children aged 18 months - 4 year olds. The width of the design of 1000mm provides a comfortable seating for one without the excessive amount of space. This also provides a comfortable intimate seating for two. The curves of the design encourages the users to face towards each other. Encouraging social interaction.

Scaled man sitting at the end of unit.

Material.

A key aspect of this design is to deliver urban furniture through the use of recycled plastics and limiting the use of traditional carbon heavy materials. The chosen material must have large strength, impact resistance and excellent UV resistance. Low maintenance is required therefore a large lifespan which will be appropriate for outside climate. Material resists mould and rotting. Material weather resistance is ideal for the Ötākaro Avon River Corridor environment.

After some research, recycled HDPE was a strong contender. The reseason HDPE is most appropriate for the design is:

Price: \$2.10 - 2.18 NZD/kg

Durability:

Aqueous solutions: HDPE is excellent when it comes into contact with water, salt water and wine. This is important as the environment notorious for flooding as well this is appropriate for the outside climate. HDPE is also excellent with soils which are appropriate for the environment. (GRANTA,2022)

Environments: HDPE has excellent resistance to marine atmosphere which may be necessary when the Avon River floods. HDPE resists mould and rotting which will help length the product life span. The use of HDPE would be beneficial is appropriate for the OARC climate as weather resistant and UV resistant. (GRANTA,2022)

Properties: HDPE is a density light weight material. This allows the moldability, machinability and weldability to be excellent. Epoxy glues also allow bonding of the material (resin-expert, 2021)

Recycled HDPE can be sourced in sheet, pallet or powder forms. Pigment can be added to the material.

Processes.

Rotational Moulding will be the primary manufacturing method as will produce the overall form. The product is made up of 4 components. 1 out of the 4 components is using rotational moulding which will be very beneficial to this product as it reduces the total amount of parts which will decrease costs, use of carbon heavy materials and assembly time.

Rotational Moulding is the process where the rHDPE powder is released into the closed mould. The mould is heated to allow the powder to be melted. To allow the material to create the shape, the mould is rotated biaxially. Once completed the mould is then cooled while still rotating (RotoWord, 2012). The part is then removed from the mould.

Rotational moulding tooling cost is relatively low of less than \$1000 and equipment costs are low of less than \$10000. However, rotational moulding requires a high amount of labour. Between 30 - 300 hours per unit which will increase the costs required for the product. The economic batch number for the total cost will be most appropriate to produce between 50 - 5000 units (GRANTA,2022). This is most appropriate for this design, as the project scope has the potential to be larger than just the Otākaro Avon River Corridor as it progresses to Christchurch City. This is also appropriate as the design is made up of many repeating units.

For ease of manufacturing the design has no sharp corners to reduce costs as it will create complex moulds and difficulty removing the product out of the mould. Rounded corners will increase the flow of the material and create equal wall thickness. No draft angles will need to be implemented as the round seamless shape will provide ease. Using a rotational moulding method, this will create a hollow component with cut outs for the steel rods slotted for security. Because the product is hollow, reinforcement will be required to provide extra strength. This is provided through the use of kiss offs, which is a stiffening feature often used in rotation moulded parts (RotoWord, 2012). This is located at both ends of the design.

The design provides two different surface finishes, this is for the user to understand the process that this product is made from recycled materials. The two surface finishes are 20 RA (micrometres) and 560 RA. To achieve a rough surface finish a second mould will need to be required, which will increase tooling costs/ This is done by the finish of the mould. To achieve a rough surface finish of 560 RA, the mould will undergo shot peening. Shot peening is the process of the surface component deliberately deformed to create a rough surface finish. This is done by a plasting a shot at the surface at a high speed to create a dimple (TWI Global, 2022)

(RotoWord, 2012)

he second component of the design to be manufactured is he plastic plugs. These plastic plugs are to hide the joining processes and fix the overall form to the ground. These plugs are injection moulded from two moulds using recycled HDPE ranules.

njection moulding is selected as the production rate is very uickly considering the plugs are very small in size. This method is most appropriate for large volumes. This is ideal, as each unit produced, 16 units may be required. Because of the imple model required, the tooling costs and equipment costs are decreased, however it is still relatively expensive.

(Granta, 2022)

Manufacturing.

The third and fourth component used is Summit Steel & wire D12 x 6m grade 300E Reinforcing Bar in C25 Grade concrete. The reinforcement bar is outsourced for \$21.35 from Bunnings Warehouse (Bunnings, 2020). This component is commonly used and seen in concrete foundations. This is selected as it has ridges to help secure the bar to the concrete. This component is to fix the units to the ground to avoid theft and weather conditions. C25 grade concrete is selected as it is the most versatile concrete mix for small scaled constructions. C25 grade concrete mix ratio is 1: 2 ½ : 3 ½ (Obinna, 2020) of cement, sand and granite. The concrete slabs are 180 mm deep to allow the rebars to be fixed securely into place (Elkink, 2014). C25 concrete is commonly used for footings and foundations used in commercial and domestic projects as it has a strength of 25 Newtons/28 day for the embedded rebars. (Easymix, 2014). The amount of concrete needed for each unit is 0.151 square metres (58kgs). With labour costs starting from \$80 an hour and reinforced concrete costs 0.0601 - 0.0901 NZD/kg (GRANTA, 2022). For a total average cost of \$4.36 per unit plus labour costs.

Ōtākaro Living Laboratory and Christchurch City Council are wanting to deliver an alternative approach to street furniture accessible to the general public throughout the Ōtākaro Avon River Corridor (OARC).

To increase the livelihood of the quiet location the final concept creates a fun interactive resting place for adults and families. Due to the repeating units this design is able to be customised to the location. Therefore, with large traffic flows multiple repeating units can be found to create an abstract exercise/ seating area. As having multiple allows young children to climb and play on. As well as those who are wanting to exercise can use the elevated surfaces to their advantage.

The final concept has delivered that by reducing the use of steel by using recycled HDPE to deliver a rotational moulded design. To communicate to the users, the final concept comes in two opposing surface finishes. This allows the user to interpret the material origin of the final concept.

The use of recycled HDPE is most appropriate for this application due to weather resistance and is ideal for the Ōtākaro Avon River Corridor environment.

The units can be seen throughout the Ōtākaro Avon River Corridor, however, some areas are quieter than others. Therefore to be able to customise to the area, fewer units are found in the quieter areas. As don't want to be excessive for the quieter areas but still encourage the use of the space.

Design Solution.

User Storyboard.

There are two types of users that utilise this area. Those for their family leisurely lifestyle walks travelling through or those using it as a routined exercising route. Providing a variety of different uses the final product can deliver. This will help enhance users' experience and help regenerate the community.

Leisure.

User interaction.

the space to rest from their run or

continue their routined track run.

After 10-15 minutes users will begin to

work out

Users walk down the Ōtākaro Avon River Corridor coming towards a look out along the Avon River. Users may wish to take a break and capture the view. They see the product and approach.

Adults may approach the two units to sit comfortably, young children follow and rest on one unit or climb towards the top to perch themselves. Kids may play on the units. Both adults and children notice the differing textures. After a brief rest enjoying the view, users get up or climb down to walk away.

Recycled HDPE is the most appropriate material as the material properties are most suitable for the OARC climate. Being resistant to the climate and high impact resistance this material is most appropriate. This material allows continuous recycling and reusing.

The primary manufacturing method to deliver the organic geometry is through rotational moulding. Due to the material selection of recycled HDPE, this allows complex geometry that traditional carbon heavy materials are unable to be machined to give the same form in a cost effective way. Rotational moulding of recycled plastics can all together eliminate the steel components commonly seen in shape and joining.

Kiss Offs are used in the design to provide structure and strength in the product to ensure the product has a long product life before going through the recycled process to close the loop.

A minimal amount of steel components and concrete is used to ensure the component is fixed into place to avoid theft and weather resistance.

Injection moulded caps are made to increase the p[roduct life span to prevent water and dirt getting inside the hollow mould. This provides a seamless finish and prevents users catching their fingers in the holes.

The final concept comes in a range of surface textures and tones. The surface textures are provided through the shot peening process to create textures into the rotational moulding mould cavity. HDPE can add pigment to the manufacturing process to even out the recycled material tones

Manufacturing.

Colours.

Inspiration of the colour scheme of the units has been taken from the environment research with Christchurch City organic matter. This was supported as user's of the areas responded in the survey that they would like a blend in design. With a colour scheme of colours found in local parks of nature. The variety in colours and tones represent the different tones found in the area. Therefore having 3 tones provides variety without complicating the manufacturing processes and increasing costs.

To begin the construction of one unit in the Ōtākaro Avon River Corridor, three holes are dug to the required dimensions 180mm deep and small openings for the rebars to be placed. The rebars are then cut to desired lengths of 385,620 or 855mm by bolt cutters, depending on product arrangement. Once prepared, C25 concrete is poured into the hole.

While still wet, the rebars are then slotted and then fixed in position. String/rope may be used to help keep the bars straight and connected together or ground. The concrete is then smoothed out for a flat even surface level for the product to sit flush to the ground.

Underneath the seat form plastic plug caps are glued with epoxy to the holes not used for the reinforcement bars. Once have waited at least 24-48 hours for the concrete to set (28 days for fully set) the rotational moulded form is then slotted through the premade holes of the form. This will require two people.

Finally, to cover the slot openings for the rebars in the rotational moulded form, plastic plugs are placed with J-B WELD Professional Steel-Reinforced Epoxy which will act as a glue. This will cover the exposure of the holes creating a seamless finish as well as preventing bugs, dirt and water into the mould. This glue will also help hold the rods in place at the top. The drying time is up to 6 hours and the curing time is 24 hours.

S S D

Product:

The design must provide seating for 1-3 Christchurch public users

The design must be 50 cm-1.8 m in seat width.

The popliteal height should be 40-50 cm above the ground.

The design must have 75 - 120 cm clear grounding available at the end for wheelchair users

The design must consider the use of a backrest to increase the length of interaction with the area by 15 minutes

User Friendly:

The design must be suitable for the active Christchurch public community aged 18months+.

The design must consider the different activities users do within the environment (excerice).

The design must consider the ergonomics of users from the 5th percentile female - 95th percentile male given through Ergonomics and Design A Reference Guide

Manufacturing:

The design manufacturing process must be able to produce 1000 HDPE product units throughout the OARC.

The design must be placed on appropiate foundations.

The design must be suitable for the OARC climate for up to 15 years before maintenance and combats theft.

Material Requirements:

The design must incorporate recycled household plastic HDPE to reduce the use of carbon-heavy moterials

The design must be suitable for the Ōtākaro Avon River Corridor climate for up to 15 years before mointenance.

Aesthetics:

The design must blend in with the OARC environment through the use of natural materials.

The design must consider modular seating designs for 1-3+ users

The design must communicate a deeper meaning about the use of recycled materials for the users to interpret.

STANDARDS:

The design must comply with the Ōtākaro Avon River Corridor Regeneration Plan.

Product Design Specifications.

They must facilitate regeneration by improving the environmental, economic, social and cultural wellbeing, and resilience of communities.

PDS:

The design process for the urban furniture was focusing on regenerating the Ōtākaro Avon River Corridor area through improving the local community by increasing engagement with the area. Therefore, designing a product that caters for all activities, lifestyles and ages through the use of recycled materials was important to meet our criteria to ensure the final concept will be appropriate for enhancing the community. This allows a product to be available to the general public and potentially open for the market

Product:

It is important for the design to be practical for the intended use to encourage community use. This is achieved by designing the product focussing on the range of users. The product is designed to fit all users aged 18months+ with a variety of abilities. This is done by providing a small height of a single unit, however the intended design is that multiple units are required. This design provides seating for 1-3+ depending on the amount of units used. However, just one unit provides enough seating for 2-3 users intimately. This will encourage engagement within the community. The arrangement of the design can provide backrests to extend the interaction time with the area and product. Depending on the location, this can be made accessible for wheelchair users. The grooves in the design allows them to fit.

User Friendly:

For the product to be successful is to be user friendly to increase the community engagement. Therefore the product is designed to cater for various users with different lifestyles. This was achieved by the modular design and overall dimensions. The sizing of the unit has a small height of 235mm which will be an appropriate height for young children and toddlers. For older users, two units on top of each other will be most suitable to create a comfortable seat upon a lookout. The design considers users that are exercising through the OARC. This is achieved as users can use the product to enhance their work out. They can do this by jump squatting on to the units, running up and down the units or using the elevated surface for press ups, lunges and more. Users may use the space to rest from their run or work out.

Manufacturing:

The aim of the project is to deliver a product made from recycled plastic to reduce use of steel components. This is achieved by using recycled HDPE commonly found in households. The properties of HDPE will require minimal maintenance creating a long product life span. To be able to deliver up to 1000 units, rotational moulding will be most appropriate due to the geometry and costs. This creates a 100% recycled plastic form which eliminates the use of steel components commonly found in urban furniture designs. However, to ensure the design is fixed to avoid theft and weather conditions the design requires concrete foundations with vertical steel reinforcement bars for the plastic form to be slotted and fixed.

Aesthetics:

It is important that the design is appropriate for the location as it will help enhance users' experience and attract users to use the product. Users of the area were hesitant about the use of recycled plastic in the area and would prefer a blend in design. Therefore this is achieved by having a variety of green/blue tones the product is offered in. This will help the design blend into its natural environment without taking away from it. The design is made to be altered and personalised to the desired location to ensure the units are not too excessive for the area. It is important for the users to understand that the design is made from recycled plastic. This is achieved by applying a different texture to show the rough/ raw material origin.

STANDARDS:

Because the design is located in OARC, the design must comply with the regeneration plan. Which is that the product must improve the environmental, economic, social and cultural wellbeing, and resilience of communities. This is achieved through the use of recycled plastics delivered by cost effective manufacturing processes to encourage the use of the environment. By raising the awareness of the use of recycled plastics.

Meeting PDS.

Technical Drawings

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Part Number	Part Name	Qty	Material	Cost per unit	Mass (g)	Manufacturing Process	Manufacturing relative cost index per unit (for 1000 unit batch size)	Total Cost for one unit
MBI50-P314-08-01 -01	Plastic Cap	16	Recycled HDPE	2.10 NZD/kg	1.406	Injection Moulded	\$7.36 - 54.1 NZD	\$117.76 - 865.60 NZD
MBI50-P314-08-01 -02	Deformed Reinforcing Bar 385mm	8	Ductile Steel	3.56 NZD/m	291.589	Outsourced	-	\$10.96 NZD
MBI50-P314-08-01 -03	Foundations	-	C25 Concrete	0.060 - 0.0901 NZD/kg	58057.044	N/A	-	\$3.48 - 5.23 NZD + Labour
MBI50-P314-08-01 -04	Seat Form	1	Recycled HDPE	2.10 NZD/kg	15880.247	Rotation Moulded	\$66.50 - 162 NZD	\$66.50 - 162 NZD
	J-B WELD Professional Steel-Reinforce d Epoxy 56.8 g	1	Ероху	2.58 NZD/9	_	Outsourced	-	\$21.99 NZD
							Total Cost for one unit	
							Minimal cost:	\$220.69 + Labour
							Maximum cost:	\$1065.78 + Labour
							Total Cost Average	\$643.24 NZD + Labour

Cost model and defaults

 Relative cost index (per unit)
 (i) * 66.5 - 162
 NZD

 Parameters:
 Material Cost = 2.1NZD/kg, Component Mass = 15kg, Batch Size = 1e3, Overhead Rate = 225NZD/hr, Discount Rate = 5%, Capital Write-off Time = 5yrs, Load Factor = 0.5

Rotational Moulding batch size vs relative cost per unit graph.

Costing Table.

Cost model and defaults

Injection Moulding batch size vs relative cost per unit graph.

(Granta, 2022)

This cost table helps breakdown the costs to deliver one whole unit. Due the variety in manufacturing costs due to estimation an minimum, maximum and average is calculated to deliver the total product cost range.

These graphs help highlight the most economic batch size. This gives a rough estimate of the costs of one component. Values input to calcute the costs.

Boarded cells seen on the Gantt chart are the reality of the progress of the project. The highlighted cells are the original project plan timeline. The Gantt chart wasn't followed closely. This was due to more ideation was required as lacked a wide diverse range of ideation. However, after gaining momentum in the project providing four potential directions progress on the concepts slowed down due to no response from the client. This was an important step as feedback and clients preference on the concepts is a high priority. After deciding to wait for a response a decision to continue with the project was made. With the hold up of the project it was important to catch up to deliver the most appropriate design. Because of this set back, this restricted the amount of time required for concept development. For next time more time to allow for concept development would be beneficial to ensure the product delivered is heavily refined. Luckily due to the project requiring recycled plastic, material research was made early. This allowed time to carefully think of the manufacturing processes with rotational mould-

ing being the primary manufacturing method. The use of CAD and prototyping was greatly beneficial as it helped highlight the design flaws and helped validate the sizing of the overall component.

For next time, I will definitely use my time more wisely as each step is important and can create a domino effect. As time was robbed from the concept refinement process which directly impacts my final concept. However, overall I am happy with my final modular design as it provides a great number of uses to a variety of users along with using recycled plastic that allows it to gain its unique shape. Overall, this project has been a great test in my capabilities encouraging me to use all aspects of my degree. This project helped give myself a taste of what working in the industries will look and expect. This has been a huge step and highlights that although university may be soon over I still have a lot to learn.

Reflections.

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