

Cambridge International AS & A Level Design & Technology 9705

Component 2: Project 3

General comments

Although the project folder has been produced on A4 size paper, this has not hampered the overall impact and presentation of information. The folder is clearly set out under each of the assessment criteria.

Criterion	Comments	Mark
Identification of a need or opportunity leading to a Design Brief [3]	The candidate has described the design need accurately, including the users and situation, leading to a clear Design Brief.	3
Analysis of and research into the Design Brief which results in a Specification [7]	A range of existing products has been thoroughly evaluated with a full analysis of each. Several aspects of the environment have been examined with data on the items to be housed presented. Materials and production methods have been considered although this is not a requirement of this criterion. A full and detailed Specification is presented as the final part of this section.	7
Generation and appraisal of design ideas [16]	A very wide range of different ideas has been presented with meaningful annotations attached to each. All ideas have then been evaluated against the requirements of the Specification through overall consideration and detailed notes. Although the further development of some ideas is not a requirement of this criterion, some of the content is pertinent to the appraisal of each.	16
Modelling of ideas [14]	A scale model has been produced to a good standard although not every aspect of the design is obvious.	12
Total [40]		38

AS Product Design 2019

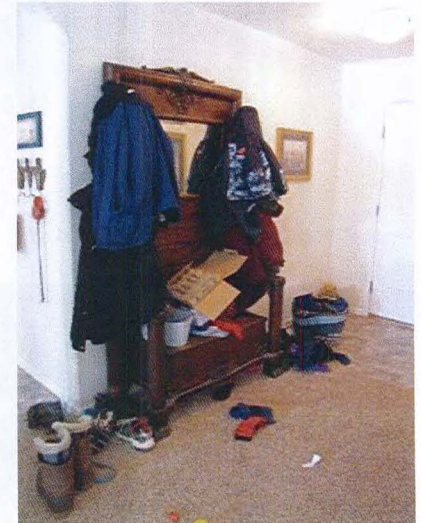
CRITERION 1

SITUATION

Many people find leaving their home to be very chaotic, especially when they are in a hurry, due to reasons such as being unable to find the right coats or shoes, house or car keys, handbags or suitcases, and other items. Many also have trouble keeping their entrance tidy, due to the large number of shoes, coats, bags etc. that need to be placed there. These people therefore need a place to tidily store clothes, shoes, keys and other items in the entrance of their home in order to keep their entrances in a clean and organised manner. Some of these people also like to have a stool to sit on while putting on shoes.

Currently, however, achieving this requires buying and placing numerous pieces of furniture and items in the entrance such as shoe racks, clothes hangers, hooks on the wall, cabinets etc., which is inconvenient and also clutters the area, making it cramped and untidy. Existing items of furniture which can perform a few of the above tasks are either very bulky and large, old fashioned, or both, making it unsuitable people who live in urban areas, who generally small, modern houses or apartments.

There is a need for a single compact unit that can address the needs of these people, while also being appropriate for an urban home's style and size.



Many entrances such as these examples one are cluttered with shoes and slippers, and large storage units are needed to accommodate these items. There is need for a small and compact unit that can provide a storage space for these and other items.



CLIENT/USER PROFILE

My clients for this project is a middle aged couple, who have a house similar to most new houses in Auckland and other urban centres. They currently lack a unit that can conveniently store their shoes and coats/jackets in their entrance, and have to go into the garage to get their keys, shoes, and bags.

They are around 50 years of age, with a teenage daughter living in the house. They both are not working and spend quite a lot of time outside of the house with friends. The husband enjoys going out with friends, often leaving early in the morning to play golf.

They are both very tidy people, and like things to be well organised and clean. The wife enjoys decorating and organising the house, and can give valuable feedback about preferred styles and personal needs.

I had a discussion with my client about their expectations for the product, and they have expressed desire for the product to:

- Be compact and able to fit in their entrance without taking up much space
- Be modern and simplistic in design
- Be able to store a large amount of slippers/shoes in a small space, while still having a neat appearance.
- Have a stool for sitting when putting on shoes
- Have a place for placing keys and hanging coats and bags



Photographs of my client's entrance and garage

TARGET MARKET

The target market for a product like the one I am designing is very large and extensive, since the issues encountered by my client are also experienced by many people around the world who live in cities and do not have much space in their homes. The product is ideal for people who live in a small to medium sized house, flat, or apartment. The users of the product will include individuals who are living, working, or studying in urban areas, as well as families who have young children. Most of these people will have shoes, bags and personal clothing and items they would store tidily in a convenient location.

DESIGN NEEDS AND BRIEF

Having had a discussion with my client, I have come up with a series of Design Needs that will take into account and address the needs of my client.

The unit I am to design should:

- Be able to store around 15 pairs of shoes
- Be able to store at least 1 pair of boots
- Have a place to sit on while putting on shoes
- Have places to store keys, hats, coats and bags
- Be a reasonable height so as to allow easy access to all stored items
- Not obstruct the front door, the side doors, or the passageway
- Blend in with the general style and colour palette of the house
- Be stable and stand without risk of falling over
- Have a sturdy construction with the use of quality, durable materials
- Be aesthetically appealing and conceal less desirable or untidy elements such as shoes and keys/small items



The entrance of my client's home, where the product will be located. There is also a door connecting the entrance to the garage, and the unit can be placed there by relocating the existing cabinet if there is a lack of space in the entrance.

DESIGN BRIEF

I will design and prototype a compact, space-saving unit to be placed in the entrance of my clients' home that can tidily store a large amount of shoes, boots and slippers, as well as keys, bags, coats and hats, and offer a place to sit while putting on shoes.

Criterion 2

RESEARCH PLAN

Type of research	Method of research	Use of information
Analysis of related existing products	Exploring related products on the internet as well as around homes and public areas that serve a similar function to my intended product. Gathering images of different forms and designs of furniture, as well as storage units such as cabinets, shelves etc. Researching designs and functions of seats and stools, clothes hooks, drawers etc. on the internet can also be helpful.	Analysing the design and function of each product, their successful areas, and areas which could be modified for improvement. Drawing inspiration from useful elements which could be implemented in my designs.
Key dimensions of location and items to be stored	Measuring the length, height, width of my client's entryway, as well as the dimensions of the free area in the garage. Knowing how far the doors open will prevent the unit blocking the way. Measuring length, width, and height of shoes and length of coats.	Knowing the limits of the space I have in my location as well as the size of items to be stored will result in a compact, efficient and appropriately sized product.
Anthropometric data of client and users in the market	Measuring the height, arm length, lower leg length of my client, as well as the seated height and position of my client and the average human.	Understanding the height and arm length of my client will help me place shelves and storage in an easily accessible location. Seated height and leg length will allow me to design a comfortable seat.
Styles and Colour schemes	Research the style of my client's house and the colours and style of furniture already existent. Consulting the client for style and colour preferences is also crucial. Researching colour schemes online and finding the effects of different colour combinations.	Knowledge of the types of styles and colours that are appropriate for my client's environment as well as the effect of different colours will help the product blend in aesthetically with its environment.
Wood types for main structure and shelving/drawers	Online research about the wood used in different furniture, the properties of these woods and its positive and negative attributes. Analysing the materials used in furniture units I come across in daily life can also be useful. Testing and trailing the properties of wood in the workshop.	Knowing what properties different types of wood have will help me choose a wood type that best suits my situation and design needs.
Metal (steel and aluminium)	Online research about properties and attributes of steel and aluminium and their use in existing products	Allow me to decide whether to implement such materials and where to use them.
Paint, veneers and finishes	Inspect existing products' finishes or veneers, and research and compare the effectiveness and visual effect of each type of outer layer. Test effect of paints and finishes on different woods in workshop.	Evaluate the benefits and uses of different finishes, and decide which one best suits my situation.
Construction and joining/fixing methods	Online research about different joining methods in furniture, their properties and feasibility, and how they were created. Examining furniture around the home/school to understand how different pieces were cut and joined. Test different construction/joining methods in workshop.	Information about different construction methods and joints will help me design a product that can be effectively and properly made, as well as guiding my method of production.
Environmental impacts and considerations	Online research of lifespan of certain materials and their impact on the environment during manufacture as well as after disposal.	Help me make sustainable choices, using recyclable, degradable, or reusable materials.

EXISTING PRODUCT 1

Function

Provides a place to hang clothes, bags and hats, a place to store shoes, and a place to sit while putting on shoes.

Performance

The product performs its intended tasks to a degree, but due to the wide spacing and very simplistic design, it does not meet its storage potential. There is wasted space beneath the bench, the hooks are spaced far apart, and there is a large gap between the top board where the hooks are placed and the bottom bench unit. There are also no cabinets to store smaller items, or shelves with doors to hide shoes from view.

Market/Users

The product targets users who want to store a small number of shoes and coats etc. while keeping good aesthetics as a priority, over practicality and compaction. Its industrial and contemporary design is intended to fit into modern homes. Its large width and height makes it unsuitable for people with limited space in their homes or apartments.

Ergonomics

The product has taken ergonomics into account in its hook height and placement. The height and width of the seat is appropriate, but the hard wood surface may not be very comfortable to sit on. Its minimal use of materials makes it quite lightweight.

Materials

Veneered MDF is cheap, lightweight as well as aesthetically pleasing, hollow steel is strong, no rusting and lightweight.

Form and Aesthetics

Aesthetics is a major strength of this product, as it is simple and pleasing to look at. The colours and materials are modern with a slightly rustic touch, making it complement a modern home well whilst still having a unique form and design. This meets the needs and desires of my intended users.

Manufacture/Construction

Steel frame is batch produced in a factory, where it is cut, welded and spray painted. MDF is machine cut and laminated. Assembled on an assembly line.

Cost

This product is slightly on the expensive side due to the quality of its materials and large size, which increases shipping costs.

Environment/Sustainability

Material usage is kept at a minimum due to the simple design. The materials that are used are recyclable and long lasting.

Possible Improvements:

Addition of cabinets and shelves to store shoes, having a padded seat and more hooks.

\$272 NZD
102L x 183H x 43W



ANALYSIS

This product is very aesthetically pleasing, and will complement the style of my users' homes. However, its lack of shelves or cabinets fails to meet my users' storage needs for shoes, and its large size makes it unsuitable and inconvenient for many users, who have limited space in their homes.

EXISTING PRODUCT 2

Positive aspects

Modern, simple and stylish design which provides abundant storage space for shoes, bags, and other items. The countertop at the top can also be used to place smaller items such as keys. The drawers open and close easily, and allow shoes to be store tidily. The use of man made board with oak wood and dark grey veneers save cost, reduce weight while maintaining good aesthetics. It also allows the product to be batch produced with consistent quality and results.

Negative aspects

The unit is very bulky and does not provide compact storage. Each drawer can only store 2 or 3 pairs of shoes, unless they are stacked up. The open gaps between the drawers can be wasted space, and its large size means it may not be suitable for many entryways. The product cannot store coats and does not have a place for sitting.

Opportunities for improvement

Addition of more shelves to store a larger number of shoes. Compressing the height of the unit and reducing empty spaces will ensure the product fits in the limited space of entryways. Incorporation of a drawer design like that of Existing product 4 will help further save space

Problems that may be encountered

Attempting to shrink the design to save space and add hooks and a bench will alter the appearance of the product, potentially sacrificing the simple, modern appearance.



107H x 79L x 40W

\$323 NZD



ANALYSIS

While the product has a unique and appealing design which complements my users' environment style, it is not suitable for my users' environment due to its bulk, and its poor usage of space means it does not meet its storage potential. There are also no hooks for coats or places to sit.

EXISTING PRODUCT 3

Positive aspects

Efficient and compact storage of shoes, adequate shelving spaced close apart reduces wasted space. Shoes are easily accessible and the height of the shelves is appropriate for the human body. Shoes can be hidden from view if desired, and the overall colour and form of the product is modern and contemporary. Small items such as keys can be placed at the countertop at the top of the unit, which is also positioned at an appropriate height. The slatted veneered man made board doors allow ventilation and view of shoes inside while keeping a tidy and stylish appearance. The open shelves on the right are also easily access to shoes.

Negative aspects

The unit cannot store coats and bags, and does not offer a place to sit. It may also be too large for some entrances, and will be difficult to transport and move.

Opportunities for improvement

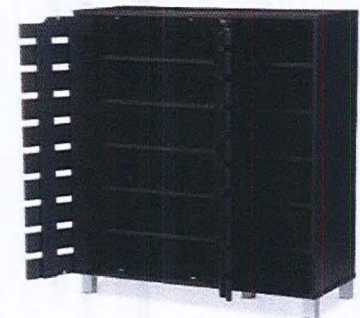
The right hand shelf could be scaled down to the height of a bench, to provide a place to sit, as well as the addition of hooks for coats and bags. The overall size of the product could be decreased, especially its length.

Problems that may be encountered

There is little space to allow for addition of hooks, and the positioning of the bench may be rather awkward due to the shelving unit being right next to it.



96H x 86L x 53W
\$340 NZD



ANALYSIS

The product's appearance is modern and aesthetically appealing, complementing the style of my users' environments. It's shoe cabinets are effective and compact, meeting my clients storage needs. However, its inability to hang coats and bags and the lack of a place to sit as well as its bulky size makes it unsuitable for my users.

EXISTING PRODUCT 4

Positive aspects

Small and compact, can efficiently store shoes in a small space, has a large area for sitting, modern and elegant design. Comfortable seat and easy opening/closing of doors, as well as an innovative drawer design that can store shoes in a compact way while ensuring they are easily accessible. It's size makes it suitable for small entrances.

Negative aspects

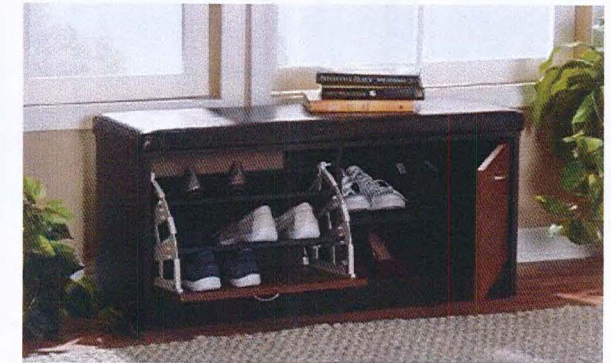
Does not provide places to hang clothes and bags, bulky construction using wood makes it rather heavy, cannot store enough shoes in order to meet my users' needs, and cannot store boots.

Opportunities for improvement

Increase the width of the shoe cabinet, or increase the height of one of the cabinets to accommodate more shoes, as well as an addition of a panel with hooks for bags and clothes to meet my users' storage requirements. Use of lighter materials such as MDF or plywood can make the product more easily to move around.

Problems that may be encountered

Increased length will risk the unit being too large for the entranceway, and will use up more materials. Using lighter materials may sacrifice aesthetics and durability, which is a important requirement for my users.



45H x 93L x 30W
20kg weight

Cost
\$173 NZD

Materials

- Foam padded seat in warm faux leather
- Man made board with two tones of wood veneer is inexpensive and gives the product strength and durability, whilst ensuring good aesthetics.
- Aluminium handles are non-rusting and lightweight.

ANALYSIS

This product has many elements which allow effective and compact storage of shoes and comfortable seating while putting them on. Its compact size and appealing design makes it suitable for my user's environment. However, its inadequate storage space and lack of hooks means it does not meet my users' storage requirements for shoes and coats.

EXISTING PRODUCT 5

Function

Entrance unit designed to store a considerable amount of shoes and provide a place to sit while putting on shoes

Performance

Effective use of space – can store shoes in a neat and efficiently. The seat is comfortable and spacious, positioned conveniently. Drawers can hide shoes from view, while the open shelves keeps shoes easily accessible.

Ergonomics

The lowest cabinets are located a small distance from the ground, ensuring the user won't need to bend down too much to access them. The drawers have large grooves to allow easy opening. There is a flat surface which is located at an appropriate height for the human body at the top of the drawers to place items. The seat's width provides abundant space to sit, and its appropriate height makes it ergonomic and comfortable.

Form and Aesthetics

The simple shape and design is elegant, modern and homely, and the dark, medium and light browns of the seat, cabinet, and legs respectively give the product a balanced, attractive look. The natural, earthy coloured materials used are very aesthetically pleasing and warm.

Materials

Manufactured board with walnut veneer, durable and cheap without sacrificing aesthetics. The foam padded seat with faux leather creates an elegant look and is comfortable.

Manufacture/Construction

Parts are batch manufactured in a factory, and user assembly is required.

Market/Users

People with medium to large sized modern houses or apartments who need to tidily store a medium amount of shoes and other items in their entrance.

Environmental impact

The product is designed to be long lasting due to its quality constructions and durable materials. The materials are also biodegradable.



66H x 89W x 39L
\$145 NZD

ANALYSIS

The product meets my users' shoe storage requirements, is very compact and functions well. The simplistic and stylish design will complement the style of my users' homes. Open shelves allow easy access and can be used in my design for frequently used shoes. However, it lacks a place to hang coats and its long length could be too large for some entrances.

EXISTING PRODUCT 6

Positive areas

Innovative and appealing design provides shoe storage and bag and coat hooks. Unit fits in corner of room so as to not get in the way of people using the entrance. Sturdy construction with veneered MDF and pine provides structural stability while keeping the product lightweight and aesthetically pleasing.

Negative areas

Shoe storage capacity is very limited and cannot store boots. The coat hanging section of the unit greatly increases its height, making the top shelf quite hard to access. The unit could also look untidy when too many coats/bags are hung on it, or too many shoes are placed in the shelf. While the top of the bottom shelf could be sat upon while putting on shoes, it is quite cramped and could be slightly uncomfortable. It's weight of 43kg makes it very difficult to transport and relocate.

Opportunities for improvement

Addition of doors to conceal shoes would help it look a bit tidier. Increasing the shoe storage space and adding more tiers of shelving will increase shoe capacity. The top of the bottom shelf could be enlarged outwards and cushioned for greater comfort.

Problems that may be encountered

Increasing shoe storage capacity will increase the height of the unit, making the top shelf even harder to access. Enlarging the seat will also increase the unit's width, possibility taking up too much space.



137H x 70L x 20W
43.08 kg

\$579 NZD

ANALYSIS

The product has a unique and interesting design, taking advantage of free space in corners while meeting my clients' storage needs for coats, bags and shoes. However, its design is not very compact and storage space for shoes is limited, and it is a little old fashioned for my users' environment. Its high price also makes it a little expensive for many of my users, who may not be able to afford expensive furniture. Its heavy weight also makes it inconvenient for many of my users to transport and carry, since many may live in apartments or flats.

EXISTING PRODUCT 7

Positive areas

Modern and very intuitive design, with aesthetically pleasing materials, shapes and forms. The unit can hang coats and bags, store shoes, provide seating, and also features a mirror. There is also a small outcrop for placing keys and small items, ergonomically positioned for easy access. There are slots in the overhang of the unit for clothes hangers to be placed in, allowing for additional coats to be hung. Veneered plywood back and seats are durable, aesthetically pleasing and can be bent.

Negative areas

The product does not provide adequate shoe storage space. When coats are hung from the overhang, they obstruct the area for keys as well as part of the seat, and may look untidy. Since the unit is constructed with premium materials and is not manufactured on a large scale, it is very expensive and cannot be readily bought. The mirror can also be easily shattered during shipping/transportation.

Opportunities for improvement

Addition of additional shoe racks or storage cabinets. Amalgamation of mirror with unit will decrease risks of breakage.

Problems that may be encountered

Cheaper materials may be less aesthetically appealing and last for a shorter lifespan. Bending MDF or plywood to form the artistic curves will also be difficult. As the unit is already quite large, any additional storage space will risk it becoming too bulky for an entryway.



ANALYSIS

The unit is very successful in its design and aesthetic aspects, and works very well in modern environments. It also has many practical and innovative features which are ergonomic and efficient. To suit my users' storage needs, it needs additional shoe storage space and a more compact, space saving design. Its complex construction and materials also make it difficult to manufacture at an affordable price, making it unsuitable for many of my users, who may not have a high income.

FULL ANALYSIS OF EXISTING PRODUCTS

EXISTING PRODUCT	Store around 15 pairs of shoes and 1 pair of boots	Have a place to sit while putting on shoes	Have places to store keys, hats, coats and bags	Be a reasonable height so as to allow easy access to all stored items	Blend in with general style and colour palette of the house	Be stable and stand without risk of falling over	Have a sturdy construction with the use of quality, durable materials	Aesthetically appealing, conceals untidy elements e.g. Shoes/small items	Not obstruct the front door, the side doors, or passageway
1 	Little space to store shoes, but can store boots	Large bench provides adequate seating space	Can hang coats and bags. Small items can be placed under the bench, but cannot be easily accessed	Top row of hooks may be too high	Modern and contemporary style and colour	Stable if leaned against a wall	Sturdy construction with iron frame. MDF may be affected by moisture.	Does not conceal shoes or coats, can become messy	Large size may obstruct entrance or be too wide for a wall
2 	Can store large amount of shoes and boots	Does not have a place to sit	Bags can be placed in holes, small items on countertop, but nowhere to hang coats	All drawers are at an appropriate height	Modern, organic colours suitable for modern homes	Squat, wide shape makes it very stable	Sturdy construction with man made board, which is strong, durable	Drawers conceal shoes and boots. Bags in holes may look untidy	Bulky size will take up too much space in entrance
3 	Can store large amount of shoes, but not boots	Does not have a place to sit	Nowhere to hang bags and coats. Small items can be placed on countertop	Shelves and drawers at an appropriate height	Modern and simplistic design suits modern interiors	Stable shape with large base	Sturdy construction with man made board, which is strong, durable	Slatted doors conceal shoes, but shelves do not have doors	Size may be a little large for some entrances

EXISTING PRODUCT	Store around 15 pairs of shoes and 1 pair of boots	Have a place to sit while putting on shoes	Have places to store keys, hats, coats and bags	Be a reasonable height so as to allow easy access to all stored items	Blend in with general style and colour palette of the house	Be stable and stand without risk of falling over	Have a sturdy construction with the use of quality, durable materials	Aesthetically appealing, conceals untidy elements e.g. Shoes/small items	Not obstruct the front door, the side doors, or passageway
4 	Compact shoe storage, but inadequate. Cannot store boots	Has a large, comfortable padded seat with leather	Does not have hooks to hang bags or coats, small items can be placed in cupboard but cannot be easily accessed	All shelves are accessible, albeit a little awkwardly due to its low height	contemporary, simplistic design suits modern interiors well	Low height and large base makes unit very stable	Use of veneered man made board, which is strong and durable, and visually pleasing	Veneered wood gives an elegant appearance, doors conceal shoes	Very compact and small - fits in almost all types entrances
5 	Provides limited shoes storage and can store short boots	Has a large, comfortable padded seat with leather	Does not have hooks to hang bags or coats, small items can be placed in drawer or countertop	All shelves are accessible and even lowest shelves are a reasonable height	Simple and elegant design suits modern interiors well	Low height and wide base makes unit very stable	Use of veneered man made board, which is strong and durable, and visually pleasing	Veneered wood gives an elegant appearance, drawers conceal some shoes	Low but quite wide, may not fit in some entrances
6 	Provides little space to store shoes; cannot store boots	Sitting area is small and not comfortable	Can hang coats and bags. Small items can be placed on the bench, but will decrease seat area	Top shelf hard to access, shoes can be easily taken from bottom shelves	Simple, elegant colour and design, may be a little old fashioned	Tall but quite stable, since wall supports 2 sides	Use of veneered MDF, which is reasonably strong but not too durable	Rather old fashioned appearance, shoes and coats exposed to view - not tidy	Designed to fit in tight spaces, the product can fit in most entrances
7 	Has adequate space to store both shoes and boots	Large bench provides adequate seating space	Has hooks to hang coats and bags, additional coats can be hung from overhang	Overhang may be too high for some users, bottom cabinets for shoes too low	Stylish and sleek design, complements modern interiors	Tall but stable when leaned against a wall	Plywood construction is sturdy and durable	Sleek, modern design, but coats hung from overhang may look untidy	Height of unit and width of seat may be unsuitable for smaller entrances

ERGONOMICS AND ANTHROPOMETRICS

Since my product will undergo frequent interaction with the user, it will have to take into account anthropometric data in order to be ergonomic and to function successfully. This means ensuring the user can easily reach, open and close, and access the inside drawers or cabinets, shelves and surfaces, hooks and handles etc. The seat must also be comfortable, with an appropriate width, and placed at an appropriate height.

To ensure all areas of the unit can be conveniently reached and accessed by my users, I will need to collect anthropometric data regarding average heights, shoulder heights, and arm lengths in order to decide how high the top shelf should be located (1). To ensure the seating area is ergonomic and comfortable, I must gather data regarding average adult leg length, seated height, and hip width (2). When designing handles and drawers I will need to find out about hand sizes, finger length and grip radius (3).

To ensure shoe cabinets are the correct size and hooks are placed at an appropriate height, I must research shoe and boot sizes, coat lengths, bag sizes and weights. Since my potential users will be both men and women, as well as people of different ages, I will take the average values for these different groups.

Type of data	Measurement/mm
Average height	1718
Shoulder height	1347
Arm length	707
Maximum height reach	2054
Lower leg length/knee height	528
Upper leg length	417
Seated height	860
Hip width	372
Hand length (Middle fingertip to bottom of palm)	181
Middle finger length	80
Distance of index to pinkie	65
Optimum grip radius	15

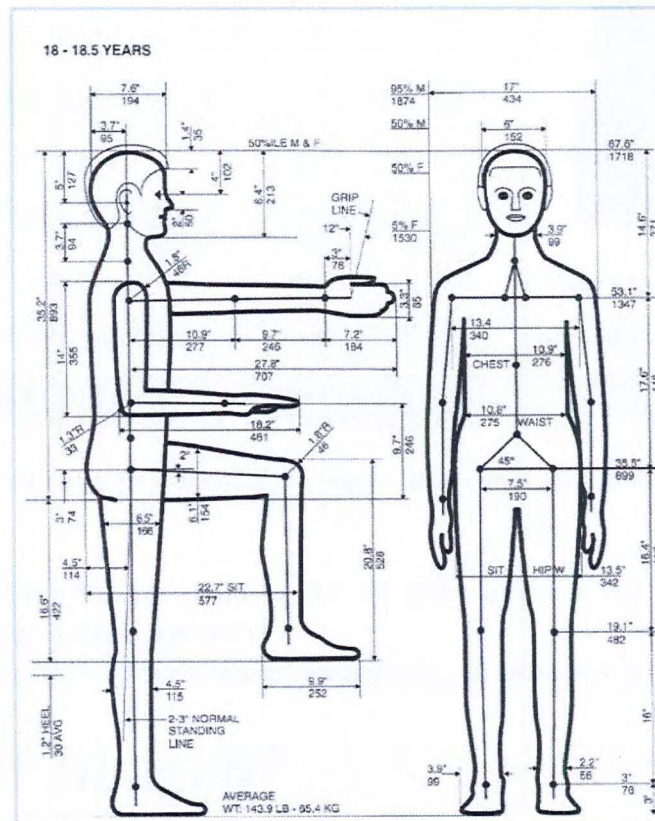


Table 5.1 Anthropometric estimates for the hand (all dimensions in mm).

Dimension	Men				Women			
	5th %ile	50th %ile	95th %ile	SD	5th %ile	50th %ile	95th %ile	SD
1. Hand length	173	189	205	10	159	174	189	9
2. Palm length	98	107	116	6	89	97	105	5
3. Thumb length	44	51	58	4	40	47	53	4
4. Index finger length	64	72	79	5	60	67	74	4
5. Middle finger length	76	83	90	5	69	77	84	5
6. Ring finger length	65	72	80	4	59	66	73	4
7. Little finger length	48	55	63	4	43	50	57	4
8. Thumb breadth (IPJ) ^a	20	23	26	2	17	19	21	2
9. Thumb thickness (IPJ)	19	22	24	2	15	18	20	2
10. Index finger breadth (PIPJ) ^b	19	21	23	1	16	18	20	1
11. Index finger thickness (PIPJ)	17	19	21	1	14	16	18	1
12. Hand breadth (metacarpal)	78	87	95	5	69	76	83	4
13. Hand breadth (across thumb)	97	105	114	5	84	92	99	5
14. Hand breadth (minimum) ^c	71	81	91	6	63	71	79	5
15. Hand thickness (metacarpal)	27	33	38	3	24	28	33	3
16. Hand thickness (including thumb)	44	51	58	4	40	45	50	3
17. Maximum grip diameter ^d	45	52	59	4	43	48	53	3
18. Maximum spread	178	206	234	17	165	190	215	15
19. Maximum functional spread ^e	122	142	162	12	109	127	145	11
20. Minimum square access ^f	56	66	76	6	50	58	67	5

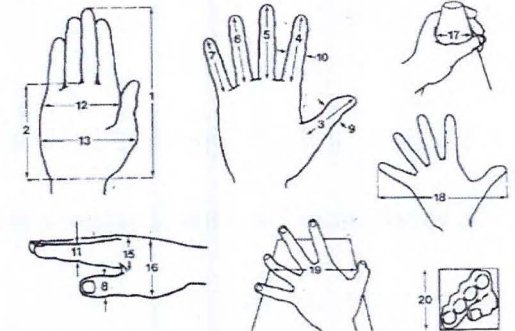


Figure 5.1 Anthropometry of the hand, as given in Table 5.1.

PRIMARY RESEARCH

KEY DIMENSIONS AND WEIGHTS OF ITEMS

The shelves and storage areas of my unit will need to take into account the dimensions of the products to be stored in order to ensure ample space to fit those items, and to avoid wasted space from oversized storage areas (1).

The weight that the items will exert on areas of the unit must also be taken into account to ensure the unit will be structurally sound, and will not crack or break apart under pressure (2). The lowest maximum mass an average person can lift will give me a guide to the mass limits of my product (3).

Thus, all weights and dimensions are the maximum value that will be encountered when my product is in use.

Type of data (1)	Measurement in mm	Type of data (2)	Mass in kg	Other useful data	Measurement in mm
Shoe dimensions	270L x 110W x 90H	Max. mass of users	90.0	minimum seat dimensions	38W x 40D x 45H
Boot dimensions	270L x 110W x 190H	Max. mass of bags	3.0	Optimum standing desk height	110
Coat lengths	820	Max. mass of boots	1.1		
Bag dimensions	460L x 270W x 290H	mass of shoes	0.8		
		mass of coats	1.7		

*Bags will require a height of 600mm to hang freely, and coats will require at least 820mm hanging height.

Type of data (3)	Mass in Kg (30 th percentile)
Max. mass an average person can lift	30kg



Ergonomics Analysis and Conclusion

Gathering of anthropometric data allows me to deduce that the maximum shelf or hook height must be no more 1700mm, all handles or slots must be greater than 65mm in length, and cylindrical knobs must be between 15mm – 40mm in radius.

Boots need a minimum space of 270L x 110W x 190H, shoes need 270L x 110W x 90H, and coats and bags need at least 820mm beneath their hooks. Seat size should be more than 38W x 40D x 45H, and the countertop should be around 110mm high.

Weights of my users and other objects will assist me in designing and testing appropriately strong joining methods, materials, structural designs etc. ensuring my product is of sound quality and is of durable and sturdy construction, and research on the masses that the average person can lift indicates my product must not exceed 27kg.

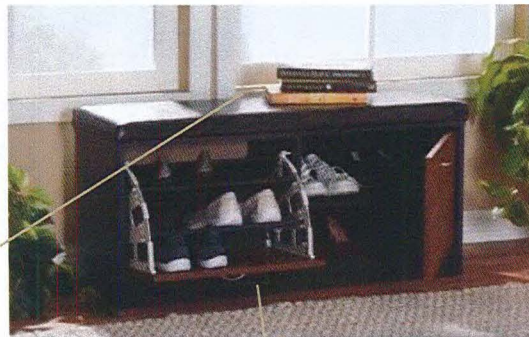
ERGONOMICS OF EXISTING PRODUCTS



Curved drawer front creates ergonomic handle, and is easy to manufacture without additional parts required.

Legs raise height of shelves, making them more accessible, and allows for easier transportation of the unit

Wide seat spans the entire width of product, providing adequate space for two people to sit when putting to shoes



Highly compact shoe cabinet design, opens to reveal shoes which can be quickly removed or placed into shelf.



Small platform for wallets, phones, keys etc.; positioned at ergonomic height and curved for easy access to items



Open shelving allows quick access to frequently used shoes

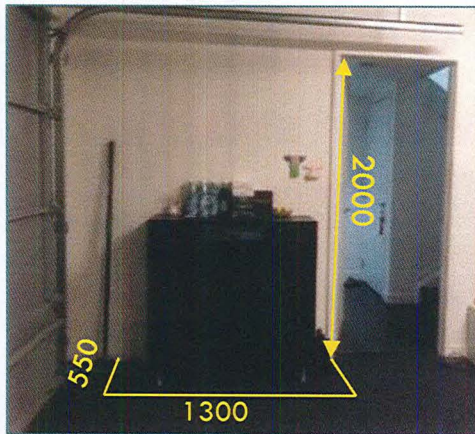
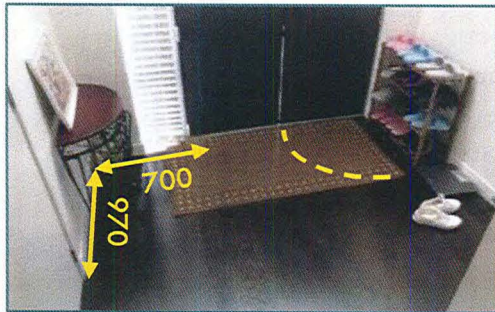
Wide seat spans the entire width of product, providing adequate space for two people to sit when putting to shoes

ANALYSIS

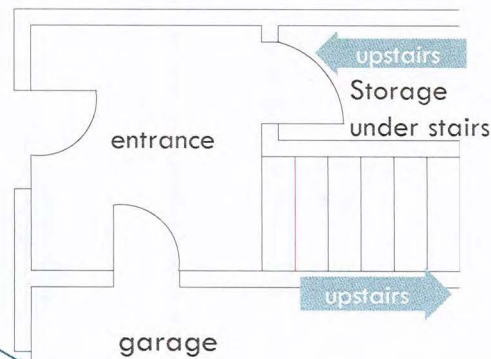
Having seen the ergonomic benefits of the above elements, I have decided to implement the compact cabinet design, the wide/padded seat, the open shelves, and the drawer designs in some of my initial ideas.

ENVIRONMENT — CLIENT'S ENTRANCE

Gathering the main dimensions of my client's entrance is key in determining the size restrictions of my unit. I will also find out the dimensions of the area beside the door in the garage leading to the entrance. If there is a lack of space in the entrance, the unit can be placed there instead.



The area beside the garage's door that leads to the entrance is constrained by the garage door, the interior doorway, and the path of the car as it enters and exits the garage.



My clients' home was constructed in 2013, is quite modern in style. The colours and architectural design reflect a simplistic and relatively minimalistic style. My clients' furniture is generally a contemporary style — mostly with a white veneer or made from polished mahogany wood.

Since my product is intended for use in urban areas with new, medium to high density housing, homes will generally be a similar style to my clients' home.

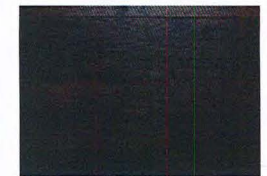
Colour Palette



Mahogany -
furniture



Beige —
walls



Brown/black -
floors



Black —
Garage carpet



White —
Cupboards and
modern furniture



Raw umber —
Existing shoe rack
and entrance mat

ANALYSIS

The dimension limitations of my product is 1000W x 1800H x 650D (in mm), and the styles and colour schemes of my environment is modern, with beige, white, and darker wood colours. This data will allow me to design a suitably sized unit that will fit in aesthetically with its environment, as well as the similarly designed homes of my potential users.

WOOD RESEARCH

YAKA - HARDWOOD

Yaka is known for its high density and durability, and red-brown colour. It has a great colour variation and dark streaking, making it ideal for use in many furniture and flooring. Its grain is usually straight but sometimes wavy. Yaka looks like New Zealand Heart Rimu with a more distinctive colour variation.



250 x 25cm block
\$14.50 NZD per L/M

Yaka Properties

Yaka is very dense and resembles New Zealand Heart Rimu. It is quite easy to work with.

Durability

Yaka is quite durable for indoor use, but may rot if used in outdoors when in contact with the ground

Machining

Yaka cuts and saws quite easily but there may be occasional slight to moderate chipping. It sands and polishes to a good finish. It also holds nails and screws securely.

Gluing and Coating

Yaka coats and oils well and can hold glue with high strength.

MDF RESEARCH

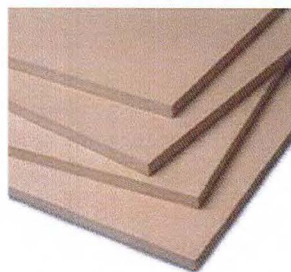
MDF (Medium Density Fibreboard) is made by breaking down hardwood or softwood residuals into wood fibres, then mixing it with wax and a resin binder and compressing under high temperatures and pressure to form boards.

MDF Properties and uses

MDF is a versatile man made board. It can be easily cut, sanded or machined since it is knot-free and fine. Because MDF has no grain and can be machined and finished without damaging the surface. However, due to its fine particles, glue, fixings, and screws etc. may not hold and could split the MDF under pressure. MDF will also soak up moisture and swell if not waterproofed.

Its properties Include:

- Dense, flat, and stiff
- Easy to cut and machine
- May split under pressure
- Does not hold fixings and screws very well.



1000 x 1000 x 12mm
board \$19 NZD

Safety

Be mindful to ventilate the room or wear a mask when cutting large amounts of MDF, as it contains chemicals harmful to health.

PLYWOOD RESEARCH

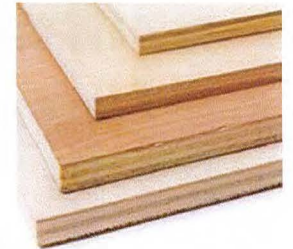
Plywood from the family of manufacture boards. It is made by gluing a number of thin wooden veneers together. These veneers can be made of hardwood or softwood. The more layers that are compressed in the board, the more durable it is. The wood grain in each layer can be rotated up to 90 degrees, allowing more durability.

Plywood properties and uses

Plywood can be quite durable if the right type is selected. It is used for roofing, flooring, interior/exterior cladding and panelling.

It properties include:

- Resistant to shrinking and warping
- Resistant to splitting and twisting
- Different wood types used can create a variety of colours and grains.



1000 x 1000 x 12mm
board \$16.50 NZD

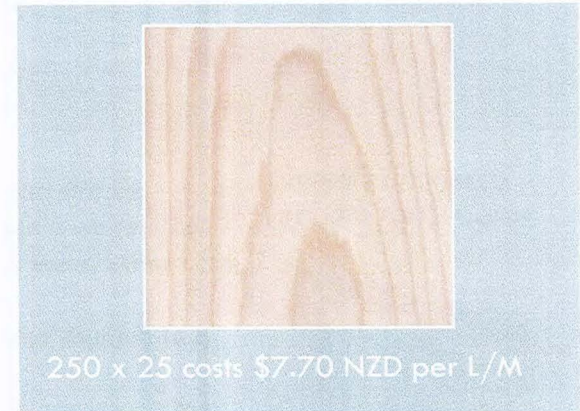
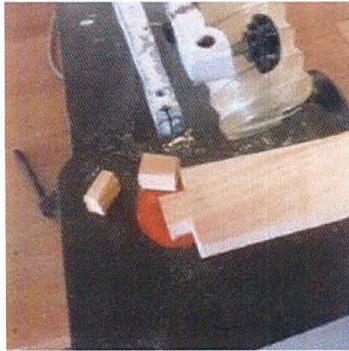
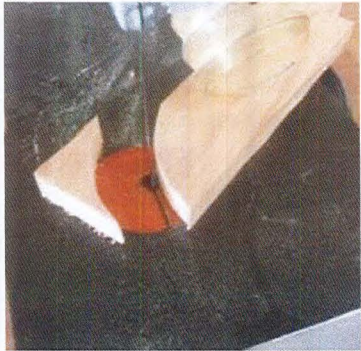
ANALYSIS

Research of wood properties and characteristics will help me make informed choices about what material to make my product out of. Yaka is aesthetically pleasing and durable, MDF and plywood are cheap and easy to work with, but are less aesthetically pleasing. Wood prices will also allow me to estimate the price of my product.

Primary Research - Materials Testing

Testing cutting and shaping

I selected four types of wood to trial: Radiata Pine, Yaka, Plywood, and MDF. This is since my unit will be quite large, therefore the wood needs to be readily available, easy to cut, and lightweight. I intend to use Radiata pine and Yaka for the visible areas, and plywood and MDF for the interior shelves and supporting structures. I marked out a shape with a curve on a piece of Radiata Pine and cut it with the scroll saw. It was quite easy to cut and the blade could be manoeuvred to create a smooth curve. I then marked out another piece that represented a section of a finger joint and cut it on the scroll. I then smoothed the edges of both pieces on the disc sander and the faces with the orbital sander. I also noticed that Pine dents and scratches easily due to its low density.



I selected a piece of 16mm plywood and cut it on the band saw. The curve was quite easy to cut and there were minimal burn marks. I created an indent in the plywood for the finger joint using the scroll saw, which also cut the plywood easily. After smoothing out the indent with a square file, I joined the plywood and Pine together with wood glue and clamped it. The result was a strong and effective joint.



MATERIAL ANALYSIS – Radiata Pine

Working with Radiata Pine was very easy and efficient. However, I noticed that it dented and scratched very easily, an issue that could be resolved by applying a durable varnish. Pine is therefore a viable material for my product, and its availability, good machining and gluing properties, light weight, and appealing grain makes it a good choice for the main body of my unit. Plywood was also easy to cut and sand, although cutting it too fast resulted in burn marks. It also chips easily when filed against the laminated layers.



Primary Research - Materials Testing

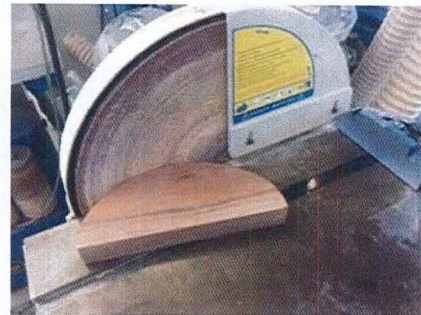
I selected Yaka to be tested in order to see whether it would be suitable for certain areas of my product, especially areas prone to scratching and denting, as well as areas where aesthetic appeal is important.

I first selected a plank of Yaka and planed the edges until they were smooth. Yaka planed very easily and did not chip.

I then marked out a semicircle and the piece on a band saw. Yaka cut easily and there were minimal burn marks.

I further trimmed the tighter curves on the scroll saw, but this was a little difficult due to the thickness of the piece giving it a tendency to jump. However, the final result was satisfactory.

I further rounded the piece on the disc sander, and a clean, smooth curve was achieved.



After sanding I filed the edges and sanded the surfaces to produce a smooth, clean surface for varnishing. I used a mixture of Linseed oil and Turpentine, which gave the Yaka a glossy and deep coloured surface, as well as bringing out the grain of the wood. I applied 2 coats and left overnight.

The final result was pleasing, with the varnish staying on the surface and giving the wood an appealing finish.



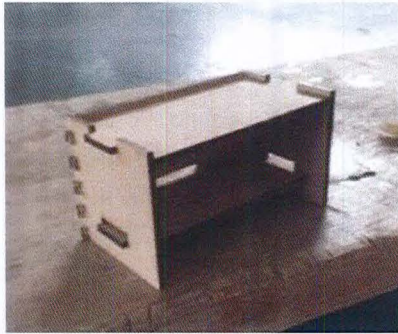
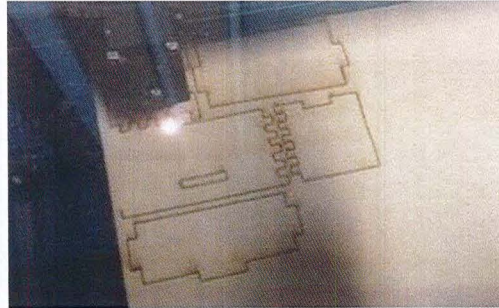
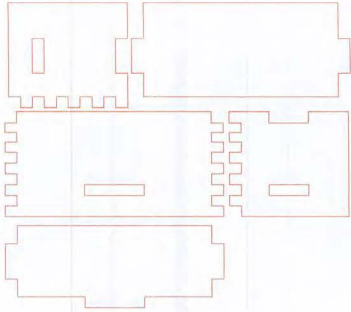
MATERIAL ANALYSIS

My design needs requires my unit to have a durable, sturdy and aesthetically appealing construction, and Yaka meets all these requirements. Yaka machined and cut very well, took varnishes well, and did not scratch or chip. I will use Yaka on the top surfaces of my unit, since these areas regularly have items placed on them, and are especially exposed to denting and scratching. Doing so also gives the product a more elegant and quality appearance, as Yaka has a very strong grain pattern and a deep rich, shiny surface when varnished.

Materials and Construction Methods

Laser cutting

I also used 2D design to design a box/small shelf to be laser cut. I selected 3mm MDF to test out the effectiveness of the joints created by the laser cutter and cutting properties of MDF. With maximum power and 4% speed, the MDF was cut with minimal burn marks. I then glued the joints and clamped them overnight. Using the disc sander, I sanded away the excess material, and smoothed out the surfaces with the orbital sander. The finger joints were very effective and strong, and were easy to create.



Analysis of results

MDF was very easy to laser cut, sand, and glue. Laser cutting MDF provides an easy, cheap yet effective way of creating components of furniture – especially joints and more intricate shapes. The laser cutter can be used in creating the inside of my drawers, shelves and the back of my unit, since those areas do not need to be highly aesthetic.



Using Router to Create Edges

The router can be fitted with a wide range of router bits to achieve a variety of edge profiles. I chose a Roman Ogee router bit which creates a classical edge profile. A length of Pine was pushed along the router until a clean edge was created. I then used a half round file followed by fine sandpaper to smoothen the curves created by the router. The process was straightforward and simple and the result was very aesthetically pleasing.



Analysis of results

The router is able to create very aesthetically pleasing and clean edges to wood, and I can definitely use the router to create edge profiles for my seat, drawers, table top, cupboard doors etc.

Materials and Machinery Testing

Testing of Domino Machine

The domino machine is a power tool that hollows out a slot in a piece of wood for dominoes to be inserted into in order to create a domino joint.

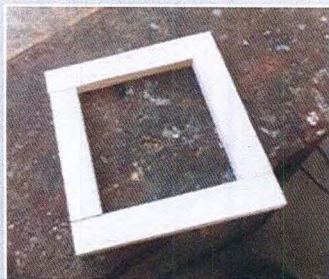
I selected 4 pieces of pine to join into a frame. After marking out the points of joining and measuring the thickness of the wood, I adjusted the domino machine to cut a slot at the appropriate position and at a suitable width and depth. The machine was lined up with the marked lines and the cutting piece inserted into the wood.

There was minimal dust due to the in-built extraction of the machine, and the cut was both clean and easy to create. I secured the piece in a vice and inserted the domino into the slot, placed the corresponding piece with its slot above the protruding domino, and hammered the pieces together with a mallet. The joints were very secure, and even without glue, the wood pieces held together firmly.



Analysis

The domino machine was very easy to use and highly efficient in creating effective joints, and could be used in my project for joining a variety of wood intersections.



Testing Chiselling Properties of Pine

I clamped a piece of Radiata Pine in a woodworking vice, and used a small chisel and mallet to create a groove in the surface of the wood. With shallow cuts, the pine responded well to chiselling and a clean and even groove was created.

Testing Planing Properties of Pine, Yaka and Rosawa

I used a Jack/wood Plane to smoothen out the edges of 3 different types of wood. I clamped the wood in a woodworking vice with the edge facing upwards. I then pushed the jack plane in the direction of the grain multiple times to smooth out the edge. For Pine, the blade cut through the wood very easily due to its low density. Yaka was slightly more dense but still fairly easy to plane, although it meant the blade had to be adjusted to create shallower cuts. Rosawa was very dense and required more force to plane, and I retracted the blade to a minimum and took off a little material each time to avoid the plane catching onto the dense wood.



Analysis of wood properties

Of the three wood types, pine was the easiest to plane, and it chiselled well due to its even grain and low density. Rosawa is much more durable but is also a lot denser, making it harder to cut and shape. Pine is therefore a suitable material for my unit due to its ideal working properties.

Specifications

Materials

- 1.1 My product will be made of timber and manufactured board – namely Radiata Pine, Yaka, and plywood.
- 2.2 The timber and boards used in the product must have a durable and aesthetically pleasing finish

Function

- 2.1 My product must be able to store 15 pairs of shoes and slippers, and 1 pair of boots
- 2.2 My product must be able to hang 2 bags and 2 coats
- 2.3 There must be a seat to allow users to sit while putting on shoes
- 2.4 My product must have places to store small items such as keys

Performance

- 3.1 My product must store shoes in a compact manner, with little wasted space
- 3.2 My product must ensure all storage areas can easily have items placed and removed by the user
- 3.3 The seat of my product must allow the user to sit comfortably with ample space
- 3.4 The product must consist of a single, concise unit that saves space and is easily transported

Environment

- 4.1 My product will be made entirely of biodegradable or reusable materials
- 4.2 My product must be durable enough to withstand frequent user interaction and minor impacts from kicking, knocking, scratching

Cost

- 5.1 The cost of the materials for my product should range between \$130 - \$260 NZD

Manufacture

- 6.1 All parts of the product must be manufacturable in a school workshop, except the upholstered seat cushion, which, if implemented, can be sourced elsewhere

Market

- 7.1 The product must have a simple, contemporary design to appeal to people living in urban areas as well as younger users
- 7.2 The product must fit compactly into a box and be assembled by the user in less than 30 minutes

Aesthetics

- 8.1 The product's surface must be mainly natural wood, with certain areas being either painted white or with a dark wood varnish applied
- 8.2 At least half of the shoe storage areas must have doors or drawers to conceal stored items
- 8.3 the outer surface of the unit must have no more than 3 main colours to reflect a contemporary, minimalistic style

Ergonomics

- 9.1 The maximum shelf or hook height must be no more 1700mm
- 9.2 Each drawer must have a handle or slot that is greater than 65mm in length, or a knob that is between 15mm – 40mm in radius
- 9.3 There must be a countertop to place small items at a height of around 110mm

Size and Weight

- 10.1 The product's total dimensions must not exceed 1100W x 1800H x 650D (in mm)
- 10.2 The product must not weigh more than 30kg
- 10.3 The drawers or shelves for the shoes and slippers must have a minimum dimension of 280L x 240W x 100H, and the drawers or shelves for boots must have a minimum dimension of 270L x 220W x 190H
- 10.4 There must be at least 820mm height below the clothes hooks
- 10.5 The seat must have a surface area and height of more than 400W x 320D x 450H.

Safety

- 11.1 The product must not have very sharp corners or edges
- 11.2 The seat must be able to support at least 90kg
- 11.3 The shelves for boots and shoes must be able to support at least 1.1kg
- 11.4 The hooks for bags and coats must support at least 3kg
- 11.5 The product must not wobble or tilt when pushed or seated on, and must not topple or fall over when a person moves it.

Criterion 3

INITIAL DESIGN 1

Hooks positioned on sides, allowing long coats and bags to be hung without obstructing shelves

Simple modern design with sturdy shape meets user and design needs

Adequate space for shoe storage – easily meets client's requirements

Back of unit made of thick plywood for rigidity and strength

Steel wires secure plywood boards to the back board 60° angle

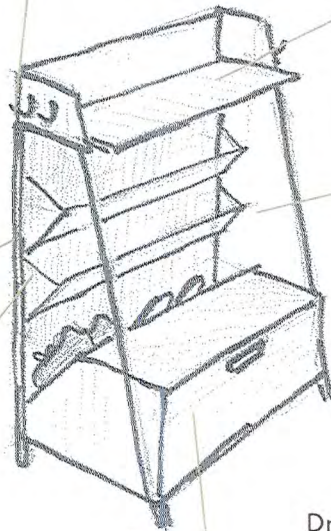
Aluminium frame – is lightweight, durable, and provides structural support. Aluminium will be welded together and bolted to wooden body

Top shelf for storage of non frequently used items, such as shoes for special occasions, boxes, baskets etc.

Inward sloping shelves save space and store shoes securely. The angle also help make them less visible.

Drawer folds out to reveal compact rows of shoes, easily accessible by the user, meeting both user and design needs

Main compartment made of radiata pine – lightweight, easy to machine and join, and cheap – opens to reveal rows of shoes, does not have the ability to store boots. Top of compartment used for seating.

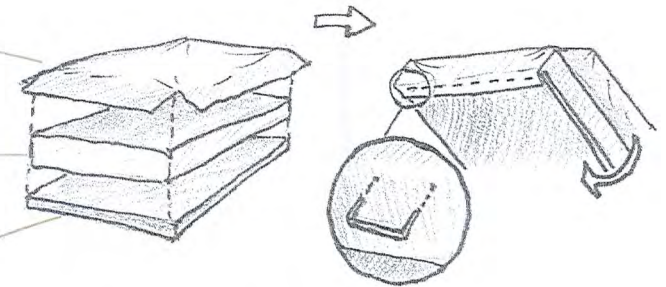


INITIAL DESIGN 2

Padded seat – foam wrapped in faux leather or cloth

Staples secure covering to bottom board. Board can then be glued onto surfaces

- Faux leather or cloth cover for aesthetics and protection
- Regular or memory foam for comfort
- Plywood or MDF base – rigid and fairly light



Total of 8 hooks provides adequate hanging space and meets design needs. Height of hooks allows for long coats to be hung

Angled storage for shoes saves space. Shoes also point towards the user, allowing easier access.

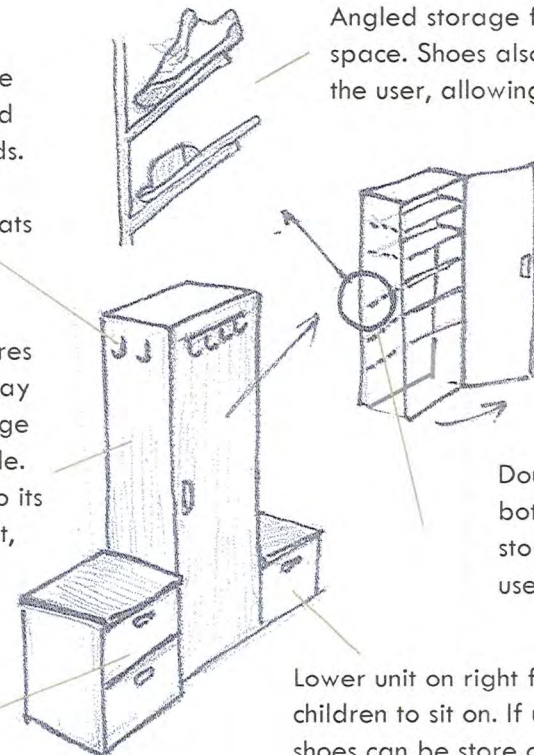
Tall central shelf stores most of the shoes; may be unnecessarily large and possibly unstable. Made of pine due to its strength, light weight, and availability

Shelving can be shifted to meet user requirements

Double height bottom shelf can store boots, meeting user needs

Regular drawers for shoes, boots and other items

Lower unit on right for younger children to sit on. If user has none, shoes can be store on the top



INITIAL DESIGN 3

4 hooks positioned at highest point offer hanging space for coats and bags

Plywood or MDF shelves, easily cut and can come in thinner boards

Back of pine or thick plywood for rigidity and strength

Large double seat provides adequate space for users to sit (see initial design 14 slide for seat designs and constructions)

Slot in drawer and shelf door creates a simple, ergonomic handle

Shoe storage design is compact and ergonomic, large number of shoes can be stored in small space and easily accessed, meeting design needs

Open storage allows easy access for frequently used shoes

Length of product may make the product hard to fit in most entrances, failing to meet this design need

Extensive storage for shoes, boots can be laid horizontally. Meets, and perhaps exceeds, user needs,

INITIAL DESIGN 4

Plywood or pine board with hooks creates hanging space for coats and bags, while being rigid and flexible. However, plywood lacks aesthetic appeal, while pine may not come in such thin boards

Yaka shelf top – Durable and scratch resistant, and aesthetically appealing. Edge profiles can be created with router

Large amount of material not utilised, except for holding up the hooks

Area next to seat for boots or other oversized or miscellaneous items, such as umbrellas

Welded aluminium bars screwed to base of unit holding boots in place

Wide, square base ensures stability, meeting design needs. However, its bulk may make transportation difficult

Open shelves allow easy access to shoes/slippers, meeting design needs, but may affect aesthetics of the product.

Spacious seat for user to sit on when putting on shoes. Can have a soft padding if desired by user

Less wide body of product decreases the amount of space it takes up.

INITIAL DESIGN 5

Radiata pine body due to its sturdiness, light weight, aesthetic appearance and affordable price.

4 hooks positioned at highest point offer hanging space for coats and bags

Large amount of drawers makes shoe storage compact by inconvenient for user access, since easy drawer must be opened individually and reached into. This becomes an issue when drawers are at a greater height, or when users do not remember the exact location of their shoes

Tall central shelf stores most of the shoes; may be unnecessarily large and possibly unstable. Made of pine due to its strength, light weight, and availability

Large bottom drawer for boots and oversized items

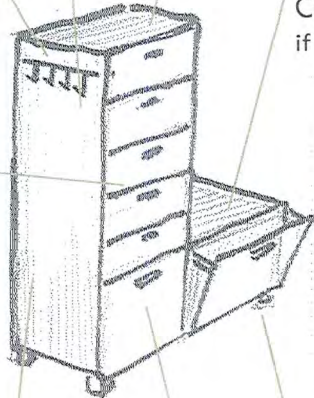
Yaka shelf top – Durable and scratch resistant, and aesthetically appealing. Edge profiles can be created with router

Seat for user to sit on when putting on shoes. Can have a soft padding if desired by user



Drawer folds out to reveal compact rows of shoes, easily accessible by the user, meeting both user and design needs

Legs raise unit off the ground, providing easier transportation. However, uneven weight distribution may impact structure of unit



INITIAL DESIGN 6

8 hooks positioned at a height offer hanging space for coats and bags, fully meeting user needs

Drawers on side of unit have limited depth. Bottom rear of unit has much wasted space that cannot be used for storage. Drawers will be inaccessible if side is placed against a wall

Unnecessarily large and bulky structure impractical for entrances of urban houses, where space is limited. However, it does ensure a stable and sturdy product

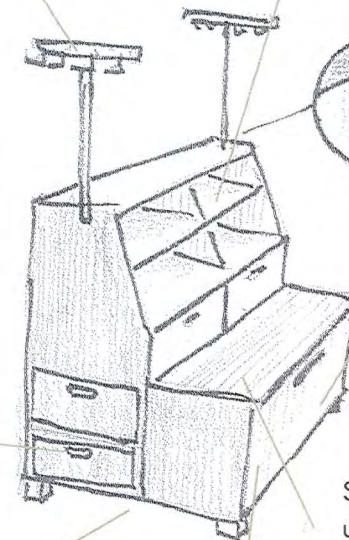
Large drawer provides boot and shoe storage, meeting user and design needs, but takes up a large amount of space and is highly inefficient as much vertical space will be wasted

Open shelves allow easy access to shoes/slippers, meeting design needs, but may affect aesthetics of the product.



Radiata pine body due to its sturdiness, light weight, aesthetic appearance and affordable price.

Spacious seat for up to 2 users to sit on when putting on shoes. Can have a soft padding if desired by user, or can be made of Yaka. However, such a large seat many not be required for most users



INITIAL DESIGN 7

4 hooks provide adequate hanging space and meets design needs. Height of hooks allows for long coats to be hung

Inward sloping shelves save space and store shoes securely. The angle also help make them less visible.

Plywood or pine boards for back and base of unit. Thicker plywood will not bend easily and can be strong, but will sacrifice aesthetic appearance. However, Pine may not come in thin enough boards.

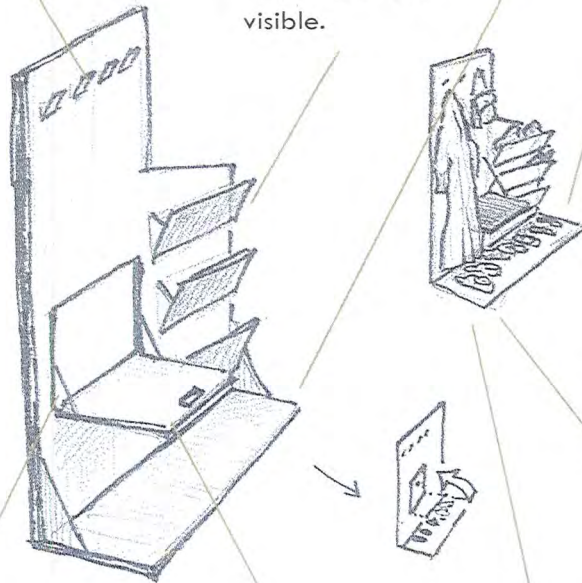
Space at the base of unit provides storage for shoes, but this may not be adequate to meet design needs. If more shoes are placed in this area, a cluttered appearance will be the result

L shaped structure with little structural support could impact on unit's durability, failing to meet design needs

Space saving design intended to be integrated into the wall of the entrance, instead of jutting out and cluttering the area, fully meeting user needs

Seat folds out when needed, and can be folded back to create a flat wall surface. This can free up space in entrances and allow users easier access to shoes underneath

Fabric or wire bands stop seat from collapsing



INITIAL DESIGN 8

5 hooks provide hanging space for coats and bags and meets design needs. However, lower distance between hooks and seat of unit may not allow for longer coats to be hung

Small Yaka protrusion offers a convenient place to put keys and small items, meeting design needs

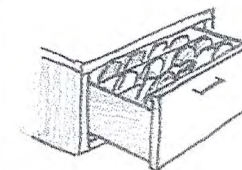
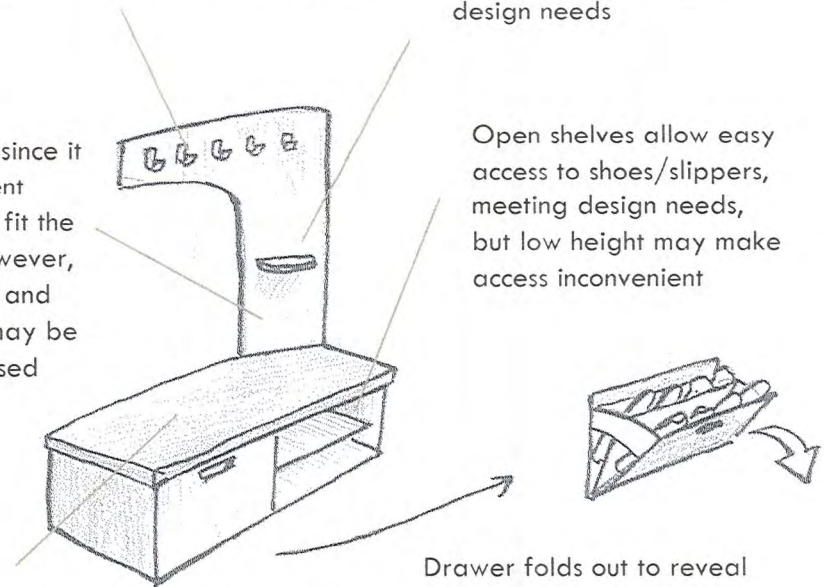
Board of plywood, since it can be bent slightly to fit the curve. However, aesthetics and strength may be compromised

Open shelves allow easy access to shoes/slippers, meeting design needs, but low height may make access inconvenient

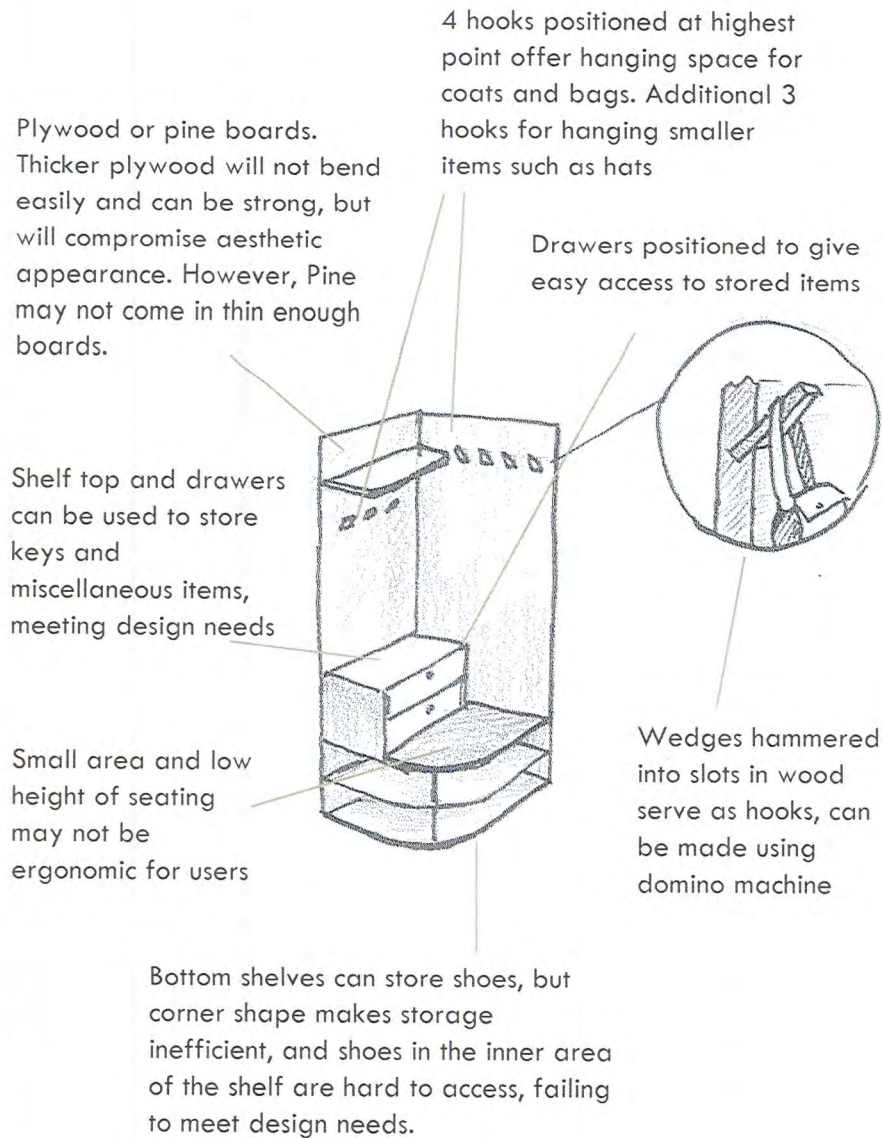
Spacious seat for up to 2-3 users to sit on when putting on shoes. Can have a soft padding if desired by user, or can have a Yaka surface. However, such a large seat many will not be required for most users and be mostly wasted

Drawer folds out to reveal compact rows of shoes, easily accessible by the user, meeting both user and design needs

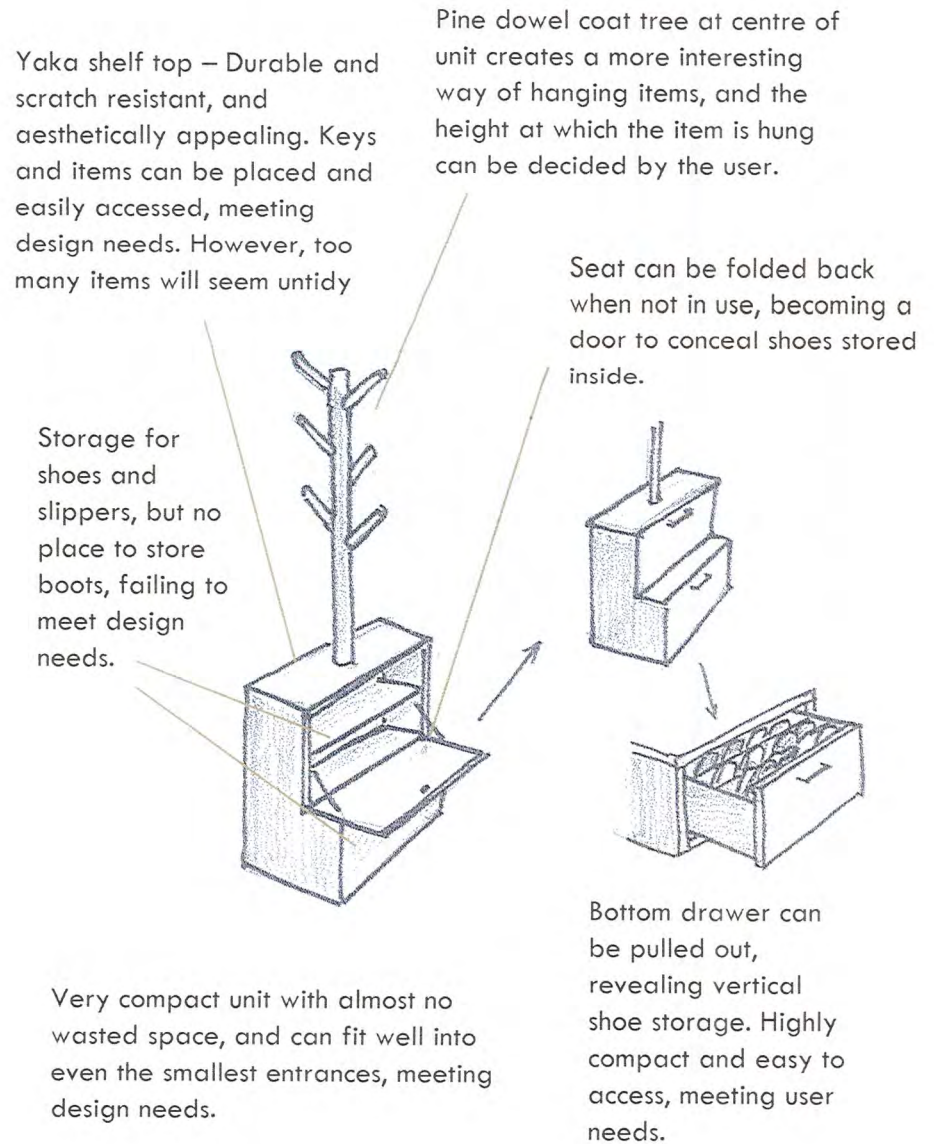
Alternative design for bottom drawer: can be pulled out, revealing vertical shoe storage. Highly compact and easy to access, meeting user needs.



INITIAL DESIGN 9



INITIAL DESIGN 10

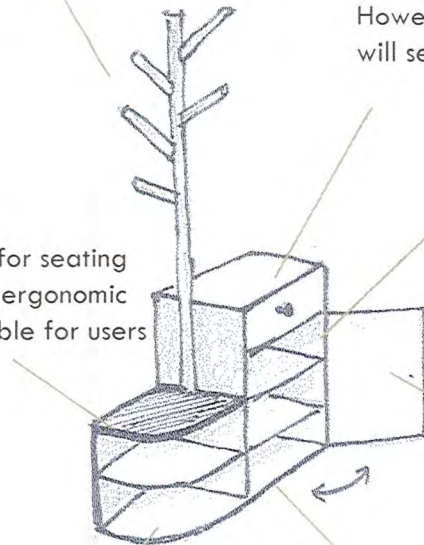


INITIAL DESIGN 11

Coat tree at centre of unit creates stylish way for hanging items, and the height at which the item is hung can be decided by the user. Can be made from pine dowel.

Yaka shelf top is durable and scratch resistant, and aesthetically appealing. Keys and small, frequently used items can be placed and easily accessed, meeting design needs. However, too many items will seem untidy

Small area for seating may not be ergonomic or comfortable for users



Plywood or MDF shelves, easily cut and can come in thinner boards

Door conceals shoes and slippers, meeting aesthetic requirements in design needs

Bottom rounded corner shelves can store shoes, but rounded-off shape makes storage inefficient, since shoes cannot be stored near the edge, not fully meeting design needs.

Storage for shoes and slippers, may not be adequate and cannot store boots, not meeting user and design needs

INITIAL DESIGN 12

Overhang offers a place to store non frequently used items such as shoes for special occasions, umbrellas, baskets etc.

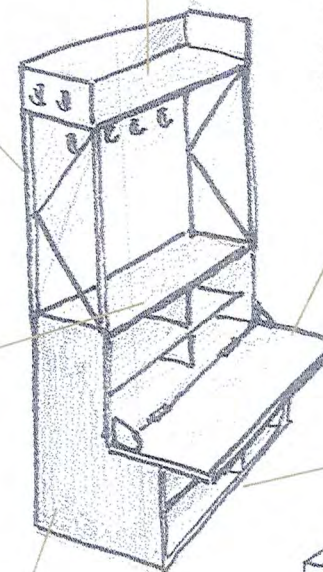
Bars hold up top shelf. Aluminium will be used due to its durability, strength and light weight.

Yaka shelf top – Durable and scratch resistant, and aesthetically appealing. Keys and items can be placed, meeting design needs

Seat can be folded back when not in use, becoming a door to conceal shoes stored inside, while allowing easy access to bottom shelves

Open shelves allow easy access to shoes/slippers, meeting design needs, but low height may make access inconvenient

Radiata pine body due to its sturdiness, light weight, aesthetic appearance and affordable price.



INITIAL DESIGN 13

4 hooks offer hanging space for coats and bags and the height at which the item is hung can be decided by the user.

Yaka shelf top – Durable and scratch resistant, and aesthetically appealing. Edge profiles can be created with router

Open shelves allow easy access to shoes/slippers, meeting design needs, but may affect aesthetics of the product.

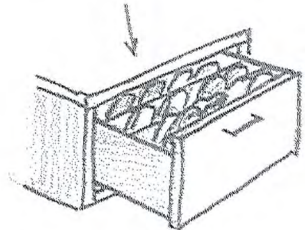
Box to store keys, magazines, and other small items, meeting design needs

Body made from radiata Pine due to its sturdiness, light weight, aesthetic appearance and affordable price.

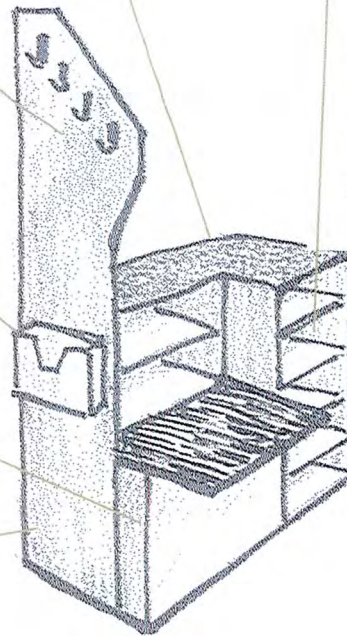
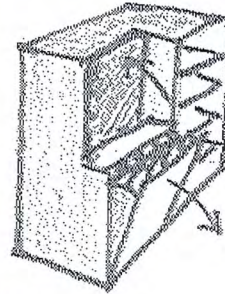
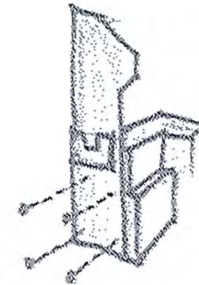
Plywood or pine board to support hooks. Thicker plywood will not bend easily and can be strong, but will sacrifice aesthetic appearance. However, Pine may not come in a thin enough board.

Seat can be folded back when not in use, becoming a door to conceal shoes stored inside. Seat can have soft padding if desired by user

Seat folds back, then drawer folds out to reveal compact rows of shoes, easily accessible by the user, meeting both user and design needs



Alternative design for bottom drawer: can be pulled out, revealing vertical shoe storage. Highly compact and easy to access, meeting user needs.



INITIAL DESIGN 14

Overhang offers a place to store non frequently used items such as shoes for special occasions, umbrellas, baskets etc.

Bars hold up overhang and hooks. Aluminium will be used due to its durability, strength and light weight.

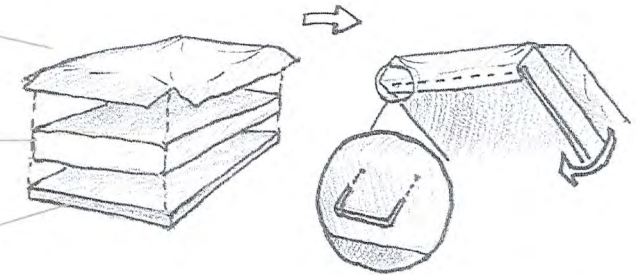
Open shelf to store shoes/slippers, shoes and boots can also be placed on top, meeting user needs

Contemporary, simplistic design fits in with style of clients' and users' homes, meeting user and design needs

5 hooks provide adequate hanging space and meets design needs. Height of hooks allows for long coats to be hung, but may also be too high for some shorter users

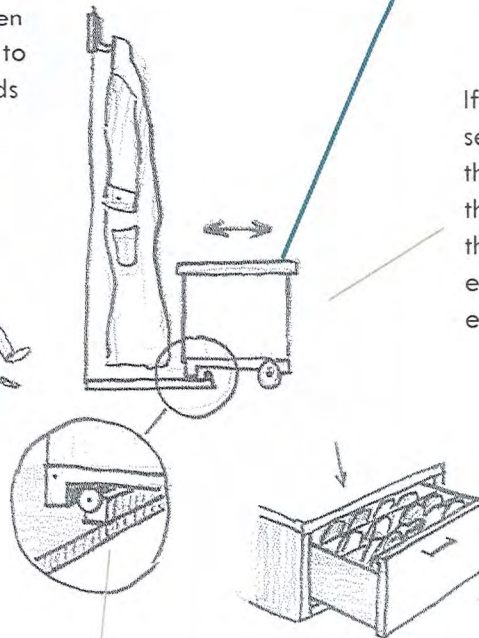
Strips of Pine create lightweight shelf. However, wood may start to weaken over time and sag, even breaking, failing to meet design needs for durability

- Faux leather or cloth cover for aesthetics and protection
- Regular or memory foam for comfort
- Plywood or MDF base – rigid and fairly light



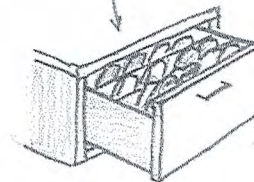
Staples secure covering to bottom board. Board can then be glued onto surfaces

If a long coat needs to be hung, the seat can be pulled out to increase the distance between the hooks and the base of the unit. The wheels at the bottom of the seat unit allow easy user interaction and good ergonomics, meeting design needs

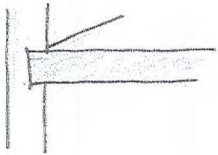


Bar stops seat unit from rolling away

Bottom drawer can be pulled out, revealing vertical shoe storage. Highly compact and easy to access, meeting user needs.

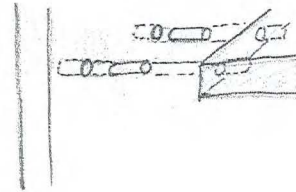


INITIAL IDEAS - SHELFING METHODS



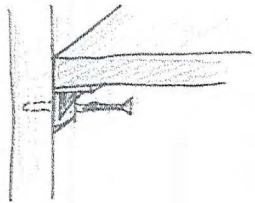
Dado Joint:

Simple and strong, prevents shelf from warping but is permanent and may weaken side as the slot for the shelf makes it thinner.



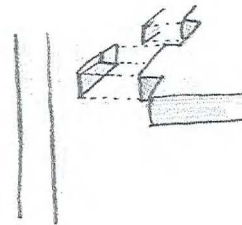
Dowel Joint

Simple and strong joint, can be easily created. Unlike the dado joint, the side panel is not made thinner, reducing risk of breakage but could reduce shelf rigidity. However, drilling into the side of a thin board will weaken it.



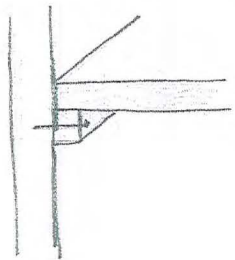
Shelf Support Brackets

Brackets are secured into side panel, and shelves can be removed or rearranged to customize storage space (e.g. To house tall boots). However, this reduces shelf rigidity and could cause warpage over time.



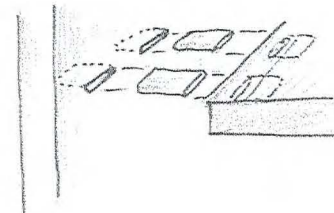
Mortise and Tenon Joint

Strong and durable joint, ensures wood rigidity while not weakening side panels. However, the joint would take longer to create since it requires cutting and chiseling.



Wood Strip

Easier version of support brackets, does not require prefabricated components. However, shelf rigidity suffers and could sag in the middle over time.



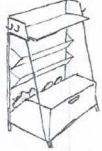
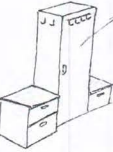
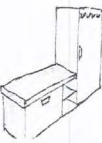
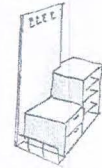
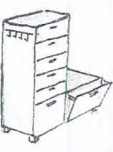
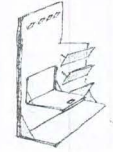
Domino joint

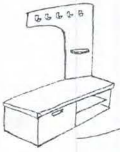
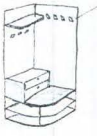
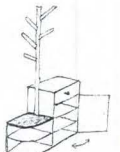
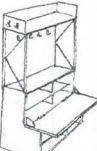
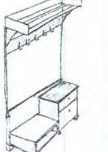
Similar to the dowel joint, but flat shape of dominoes is more suitable for the thin shelves, and can be easily created with the domino machine.

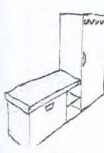
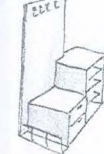
Chosen Construction Methods

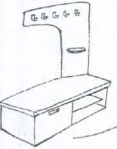
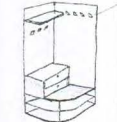
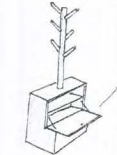
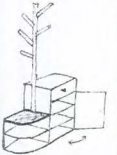
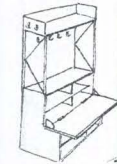
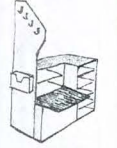
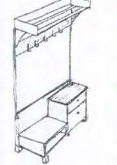
The domino joint is the most secure and efficient method, but shelves are permanent. The shelf support brackets and wood strip method allows the user to customize their storage space. Its strength can be tested by observing how it reacts to the weight exerted by shoes and boots, using either CAD or physical strength tests.

EVALUATION AGAINST USER AND DESIGN NEEDS

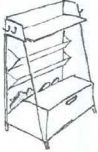
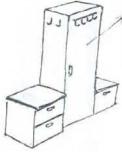
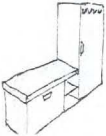
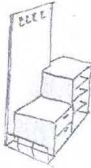
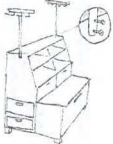
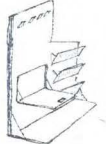
	Be compact and able to fit in user's entrance without taking up much space	Be modern and simplistic in design	Be able to store a large amount of slippers/shoes in a small space, while still having a neat appearance.	Have a stool for sitting when putting on shoes	Have a place for placing keys and hanging coats and bags
	Yellow	Green	Green	Green	Yellow
	Red	Yellow	Green	Green	Yellow
	Red	Yellow	Green	Green	Yellow
	Yellow	Green	Green	Green	Green
	Yellow	Yellow	Green	Green	Yellow
	Red	Red	Green	Green	Green
	Green	Green	Red	Green	Yellow

	Be compact and able to fit in their entrance without taking up much space	Be modern and simplistic in design	Be able to store a large amount of slippers/shoes in a small space, while still having a neat appearance.	Have a stool for sitting when putting on shoes	Have a place for placing keys and hanging coats and bags
					
					
					
					
					
					
					

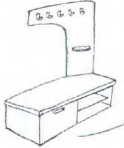
	Able to store around 15 pairs of shoes	Able to store at least 1 pair of boots	Have a place to sit on while putting on shoes	Have places to store keys, hats, coats and bags	A Reasonable height so as to allow easy access to all stored items	Not obstruct the front door, the side doors, or the passageway	Blend in with the general style and colour palette of the house	Stable and stand without risk of falling over	Have a sturdy construction with the use of quality, durable materials	Aesthetically appealing and conceal untidy elements such as shoes and keys/small items
	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	Yes
	Yes	Yes	Yes	No	No	No	Yes	No	Yes	Yes
	Yes	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No
	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No
	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No
	No	Yes	Yes	No	Yes	Yes	Yes	No	No	No

	Able to store around 15 pairs of shoes	Able to store at least 1 pair of boots	Have a place to sit on while putting on shoes	Have places to store keys, hats, coats and bags	A reasonable height so as to allow easy access to all stored items	Not obstruct the front door, the side doors, or the passageway	Blend in with the general style and colour palette of the house	Stable and stand without risk of falling over	Have a sturdy construction with the use of quality, durable materials	Aesthetically appealing and conceal untidy elements such as shoes and keys/small items
	Green	Red	Green	Green	Green	Red	Green	Green	Yellow	Green
	Yellow	Red	Green	Green	Green	Green	Green	Yellow	Yellow	Green
	Yellow	Red	Green	Green	Green	Green	Green	Green	Green	Green
	Green	Red	Green	Green	Green	Yellow	Green	Green	Green	Green
	Green	Green	Green	Green	Yellow	Yellow	Green	Yellow	Green	Green
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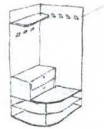
ANALYSIS OF INITIAL DESIGNS

	Positive Aspects	Negative Aspects
	Aesthetically pleasing and contemporary design, with adequate space saving storage which meets design needs. Will be taken forward for development	May be too bulky and large to fit in some entrances, as well as be difficult to transport
	Vertical storage maximises space efficiency and can store the number of shoes boots stated in design needs, and hooks can hang large number of coats and bags. Two seats at different heights are ergonomic to different users	Tall height may compromise stability, two seats may not be necessary and take up space
	Has adequate storage to meet design needs, and has a large seating area.	Width of product is too long for most entrances, failing to meet design needs. Seat is unnecessarily wide
	Compact storage for shoes and boots. Coats can be hung, and drawers and countertop can store small items	Back board wastes significant amount of material, may not be strong and could warp over time. Shoe storage may not be adequate to meet design need requirement
	Vertical storage and drawer design beneath seat is efficient and can store the number of shoes boots stated in design needs, hooks positioned to allow long coats to be hung.	Drawers must be individually opened to access shoes, height of drawers may be unergonomic for shorter users
	Has adequate storage for shoes, boots and coats to meet design needs, shelves and drawer enables easy access to shoes. Large seating area for multiple users to use at once.	Lots of wasted space and unnecessarily large and bulky structure impractical for entrances of urban houses, failing to meet design needs.
	Space saving and unique, contemporary design fully meets user needs. Minimal materials used while maximising storage reduces cost and labour to manufacture	Most storage for shoes and boots are open, meaning larger amounts of items will give an untidy appearance. Shape and construction gives potential structural weakness

Positive Aspects



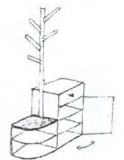
Has many hooks and a platform to store small items. Has a wide, spacious seat for two persons to sit on.



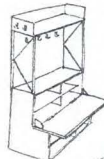
Fits compactly into a corner, has hooks for coats and hats, and convenient drawers for small items.



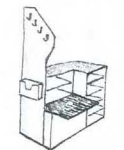
Effective, compact design fits in almost all entrances, especially ideal for small apartments. Meets user storage needs, and has a innovate seat design which is highly efficient. Will be selected for further development



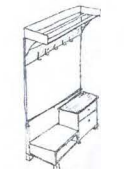
Unique and space saving way to hang coats and hats, has adequate shelving for shoes, and a convenient drawer for small items



Modern and aesthetically pleasing design, with a high storage capacity. Counter and top self provides additional storage, and folding double seat provides large seating area and saves space.



Aesthetically pleasing, contemporary design is ideal for modern homes, meeting design needs. Compact storage for all required items, as well as ergonomic and space saving seat design satisfies design as user needs. Will undergo further development.



Space saving, is a contemporary modification of a more traditional design, with added seating and storage.

Negative Aspects

Seat's size may result in wasted space, possibly not enough shoe storage space

Curved bottom shelving is inefficient in utilising space, seat does not offer enough area to sit on.

Does not have a dedicated space for boot storage, is perhaps less aesthetically pleasing compared to other, more complex designs

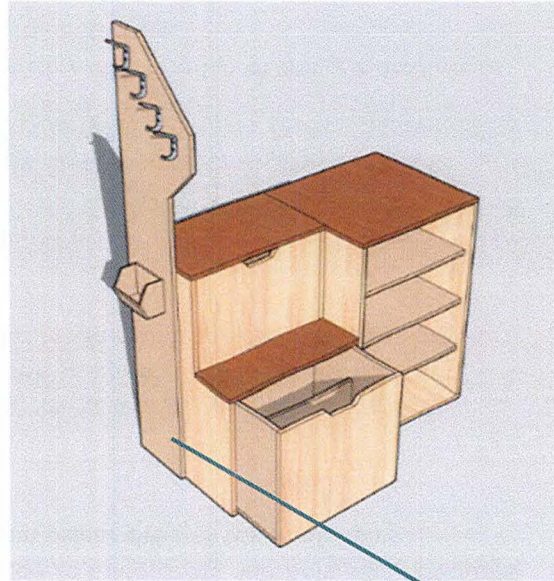
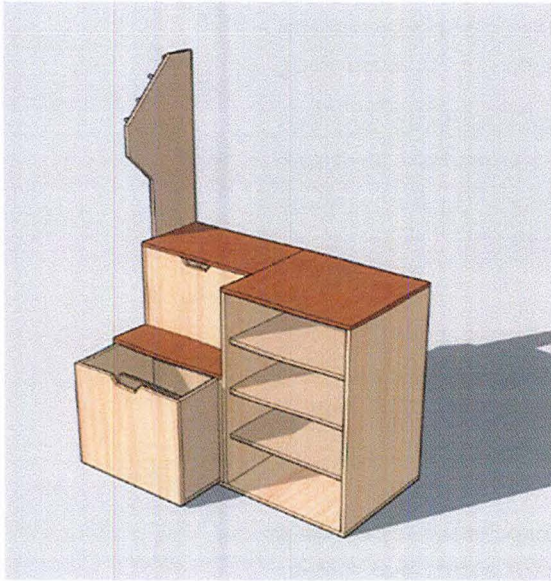
Curved corners of bottom shelving results in wasted space, coat tree in centre may obstruct shelves or seat, was well as affecting aesthetic quality.

Requires a large, bare wall in the entrance in order to be placed. Is quite bulky and heavy, and will be difficult to make in given time frame.

May be slightly too large for some entrances, and complex design may pose difficulties to construct in a school workshop in the give time frame.

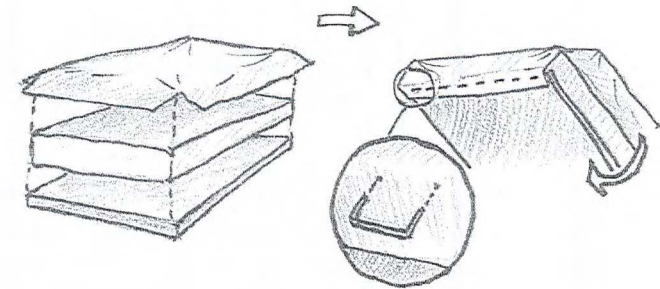
Top-heavy structure could prove unstable. Requires a large, bare wall in the entrance in order to be placed, and lacks adequate storage space.

FURTHER DEVELOPMENT 1



Soft Padded Seat

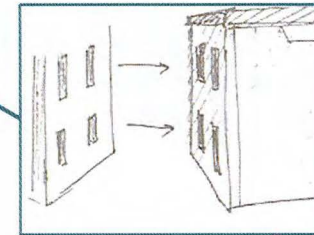
The seat itself will be made of a thin foam pad wrapped in faux leather or fabric. Magnets at the sides of the seat and the inner shelves prevent the seat from falling out unintentionally



Developed Idea

Initial design has a drawer at the bottom and a folding out seat to save space. The right shelf leaves most shoes exposed to view.

After a discussion with my client, who preferred most shoes to be hidden from view, I changed the drawer to a shelf and added a door to the right shelves.



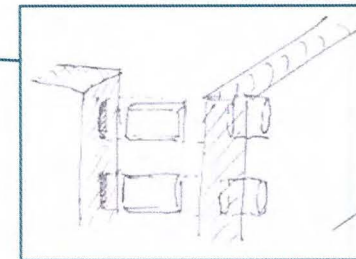
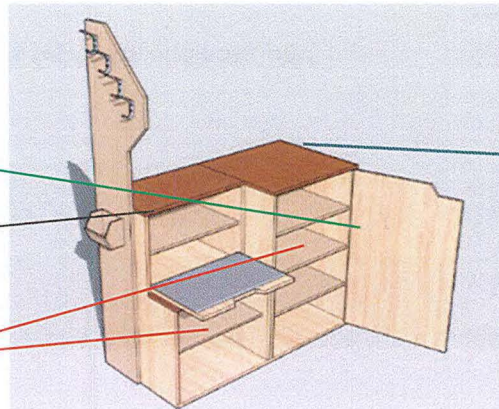
Corresponding magnets on the hook panel and side panel allow easy attachment and removal

Materials

The main body of the unit will be made from radiata pine

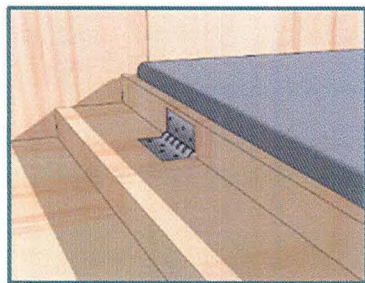
The top surfaces will use varnished Yaka for durability and aesthetics

The shelving and board for hooks will be made from Plywood for its rigidity, durability and cheap price

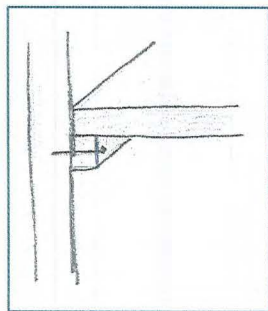
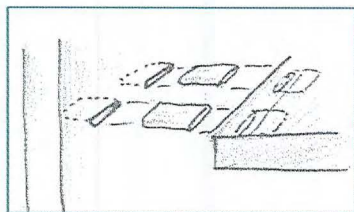


Domino joint made with domino cutter. Dominoes and wood glue secures pieces together. Simple to create and very strong.

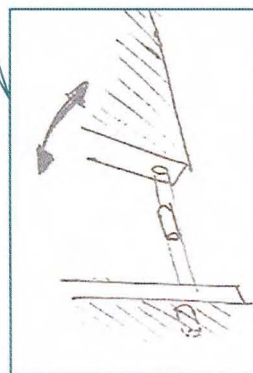
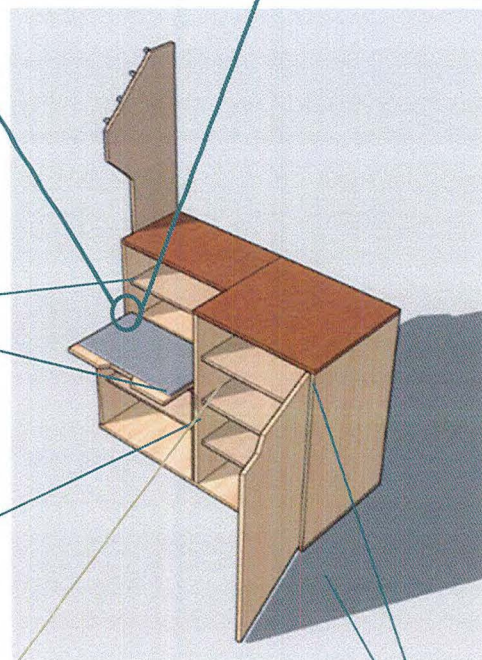
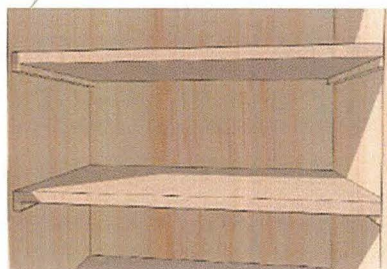
Hinges will be positioned on a raised plank of wood with countersunk slots to allow the seat to fold in and out.



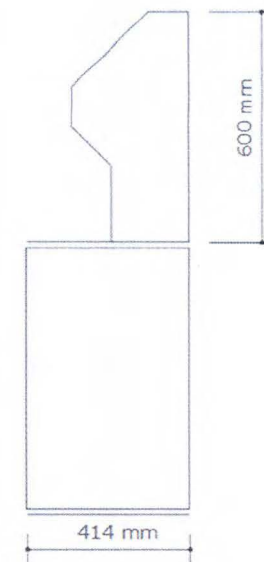
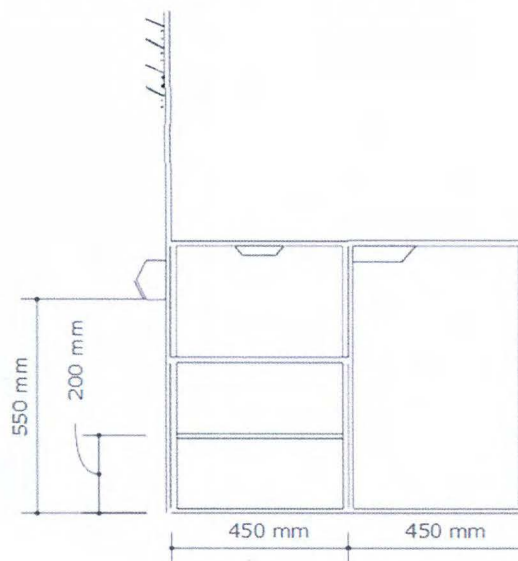
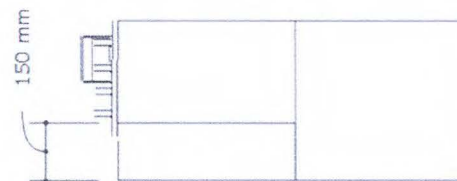
Domino joint will be used to fix the left two shelves, providing secure joining and preventing thin plywood shelves from warping over time.



The right shelves will have a wooden bar holding them from beneath; this allows the shelves to be taken out to create double-height areas for boot storage.



An 8mm diameter Hole will be drilled into top and bottom side of the door, and the underside of the yaka top and on the pine base. An 6mm dowel will be placed into the holes to secure the seat to the side panels while allowing room for the seat to be folded in and out.



Specification

1.1 My product will be made of timber and manufactured board – namely Radiata Pine, Yaka, and plywood.

2.2 The timber and boards used in the product must have a durable and aesthetically pleasing finish

2.1 My product must be able to store 15 pairs of shoes and slippers, and 1 pair of boots

2.2 My product must be able to hang 2 bags and 2 coats

2.3 There must be a seat to allow users to sit while putting on shoes

2.4 My product must have places to store small items such as keys

3.1 My product must store shoes in a compact manner, with little wasted space

3.2 My product must ensure all storage areas can easily have items placed and removed by the user

3.3 The seat of my product must allow the user to sit comfortably with ample space

3.4 The product must consist of a single, concise unit that saves space and is easily transported

4.1 My product will be made entirely of biodegradable or reusable materials

Reason

*Grey: Cannot be determined for certainty at this stage.

Design uses materials of timber and manufactured boards - Radiata Pine, Yaka, and plywood.

Timber and boards used will have a coat of varnish applied to enhance aesthetics and durability

Product is designed to store at least 16 pairs of shoes and one pair of boots. Shoe storage can be swapped for boot storage.

4 hooks allow 2 bags and 2 coats to be hung.

Folding seat enables user to sit while putting on shoes

Large countertop provides adequate space for small item storage

Shelves are arranged compactly, with minimal wasted space

All shelves are easily accessible and shoes can be quickly placed in or taken out of them

The seat is of reasonable size, and has soft padding for extra comfort

Unit is rather large and has a separate board with hooks.

Timbers and manufactured boards used in the unit are biodegradable, while metal screws, hinges etc. are recyclable.

4.2 My product must be durable enough to withstand frequent user interaction and minor impacts from kicking, knocking, scratching

5.1 The cost of the materials for my product should range between \$130 - \$260 NZD

6.1 All parts of the product must be manufacturable in a school workshop, except the upholstered seat cushion, which, if implemented, can be sourced elsewhere

7.1 The product must have a simple, contemporary design to appeal to people living in urban areas as well as younger users

7.2 The product must fit compactly into a box and be assembled by the user in less than 30 minutes

8.1 The product's surface must be mainly natural wood, with certain areas being either painted white or with a dark wood varnish applied

8.2 At least half of the shoe storage areas must have doors or drawers to conceal stored items

8.3 the outer surface of the unit must have no more than 3 main colours to reflect a contemporary, minimalistic style

9.1 The maximum shelf or hook height must be no more 1700mm

9.2 Each drawer must have a handle or slot that is greater than 65mm in length, or a knob that is between 15mm – 40mm in radius

The materials and construction of the unit are sturdy and suitable for interior use. Varnishes will protect wood from scratching.

Cannot be determined for certainty at this stage.

The wooden parts of the unit and its construction methods can all be achieved in the workshop.

The design of the unit is simple and modern, with simple shapes and colours

Cannot be determined for certainty at this stage.

All surfaces which are exposed to view are natural wood. Yaka countertop has a dark varnish applied

The right shelves, which constitute half of the total shoe storage space, has a door which conceals inner items

The dark Yaka and the lighter pine are the only two colours visible

The highest hook is positioned at 1500mm height

All slots for opening the shelf door or the seat door are greater than 65mm in length

9.3 There must be a countertop to place small items at a height of around 110mm

10.1 The product's total dimensions must not exceed 1100W x 1800H x 650D (in mm)

10.2 The product must not weigh more than 30kg

10.3 The drawers or shelves for the shoes and slippers must have a minimum dimension of 280L x 240W x 100H

The drawers or shelves for boots must have a minimum dimension of 270L x 220W x 190H

10.4 There must be at least 820mm height below the clothes hooks

10.5 The seat must have a surface area and height of more than 400W x 320D x 450H.

11.1 The product must not have very sharp corners or edges

11.2 The seat must be able to support at least 90kg

11.3 The shelves for boots and shoes must be able to support at least 1.1kg

11.4 The hooks for bags and coats must support at least 3kg

11.5 The product must not wobble or tilt when pushed or seated on, and must not topple or fall over when a person moves it.

There is a large countertop with a height of 100mm

The unit's total dimensions are 900W x 500D x 1600H

Cannot be determined for certainty at this stage.

Shelves are more than 280L x 120W x 100H

Shelves are customizable to meet the dimensions required for boots

The highest clothes hook is 1500mm high, and the lowest is 1000mm.

The seat has a surface area and height of more than 400W x 320D x 450H

There are sharp corners and edges depicted in the drawings and models, but can be smoothed or rounded during manufacture

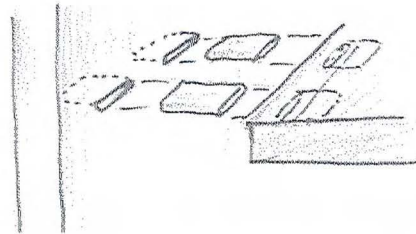
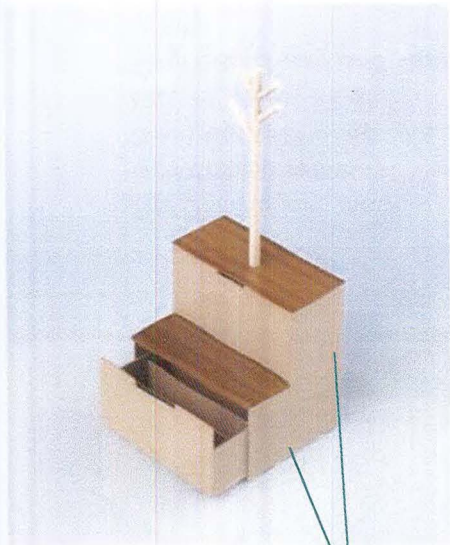
Cannot be determined for certainty at this stage.

Cannot be determined for certainty at this stage.

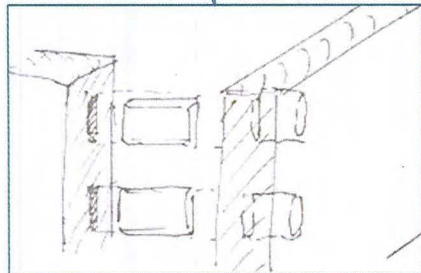
Cannot be determined for certainty at this stage.

The unit is very sturdy and squat, having a low center of mass and making it very stable.

FURTHER DEVELOPMENT 2

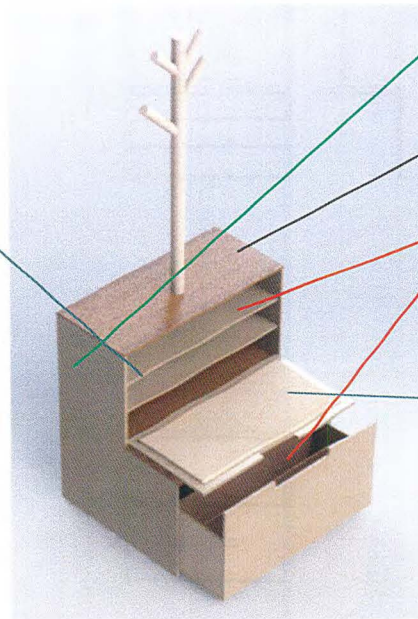
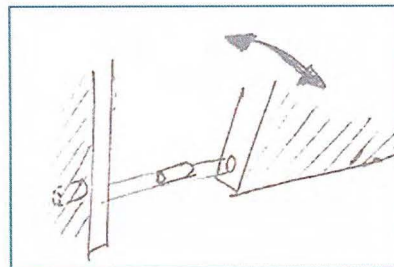


Domino joint will be used to fix the top two shelves, providing secure joining and preventing thin plywood shelves from warping over time.



Domino joint made with domino cutter. Dominoes and wood glue secures pieces together. Simple to create and very strong.

An 8mm diameter Hole will be drilled into the left and right side of the seat and the side panel. An 6mm dowel will be placed into the holes to secure the seat to the side panels while allowing room for the seat to be folded in and out.

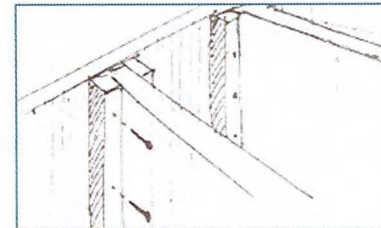


The main body of the unit will be made from Radiata Pine

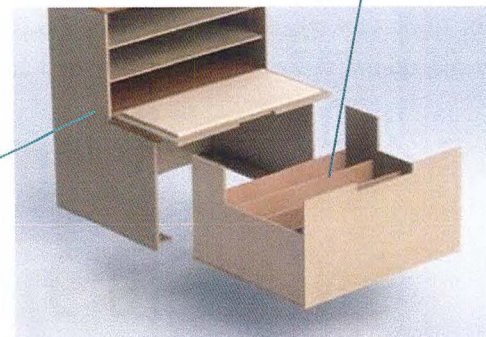
The top surfaces will use varnished Yaka for durability and aesthetics

The shelving will be made from Plywood for its rigidity, durability and cheap price

Seat with soft foam padding folds out. When not in use, it can be folded in to act as a door to conceal the shoes, while also decreasing the amount of space the unit takes up. Magnets at the sides of the seat and the inner shelves prevent the seat from falling out unintentionally

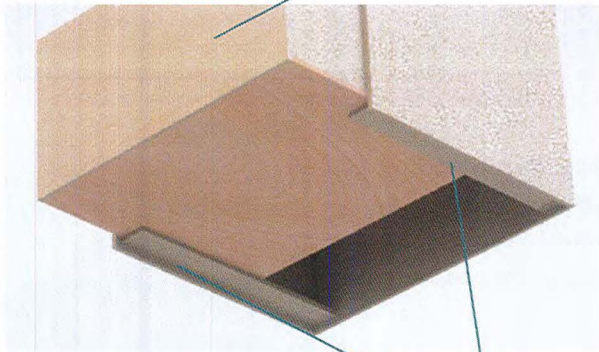
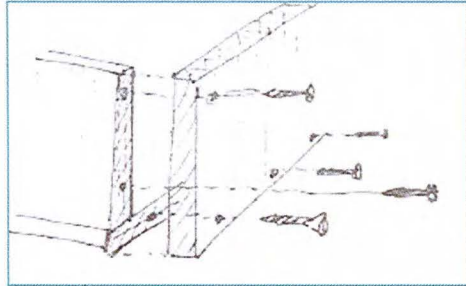


Pine strips nailed and glued to plywood sides allow plywood partitions to be inserted. These can be removed if larger items need to be stored.



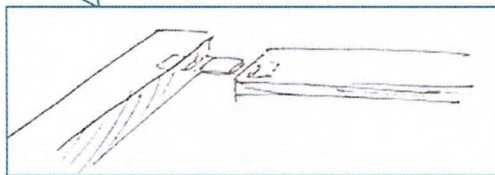
DEVELOPMENT AND ORTHOGRAPHIC DRAWING

Front of drawer will be secured to bottom and sides of drawer with countersunk screws, after which a filler will be applied to hide the screws



The underside of the bottom drawer consists of plywood planks, to allow the drawer to slide over while not adding too much weight to the unit.

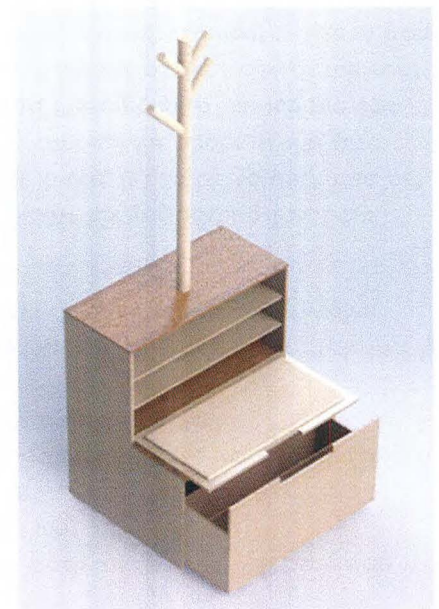
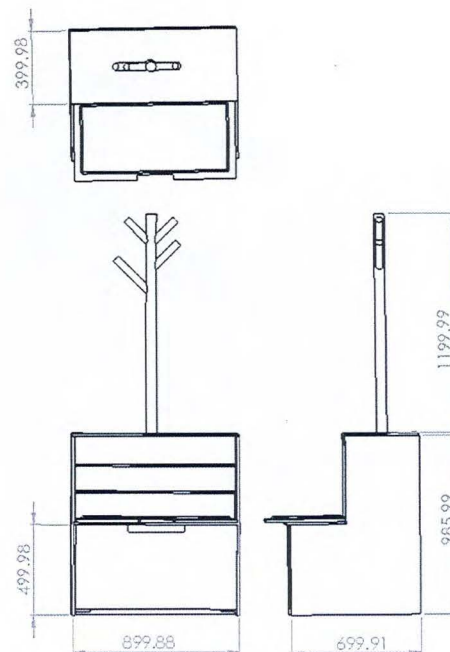
The Domino joint made with domino cutter. Dominoes and wood glue secures pieces together. Simple to create and very strong



Design Flaw: Dowel Tree

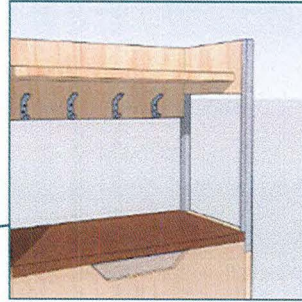
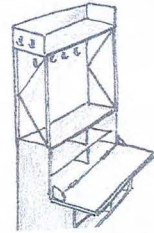
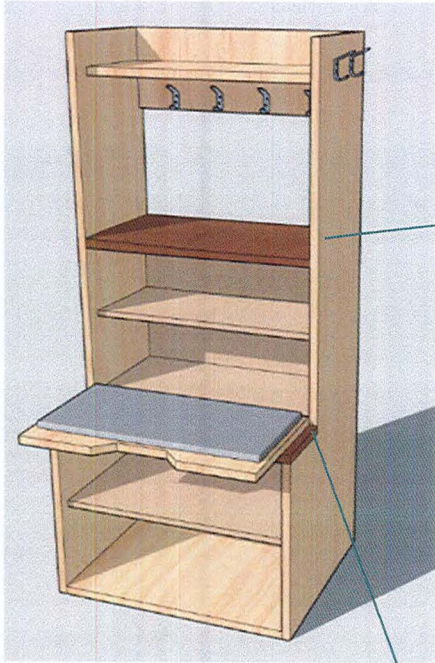
After considering the way in which the dowel will be attached to the shelf top, as well as the way with smaller dowels will be attached to the main dowel, I have realised that the dowel tree is very weak and could break easily.

To solve this, I must extend the tree down through the entire unit, but this would affect storage areas. I could also use steel or aluminium, but welding would be difficult, weight would be increased, and I would still need to extend the rod through at least the top shelves.



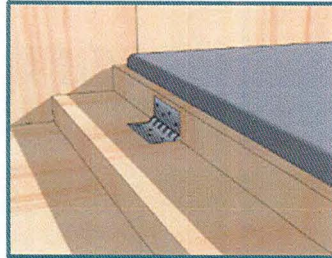
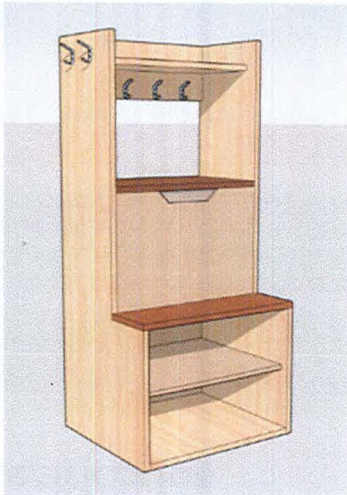
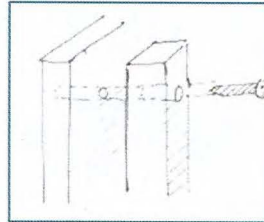
FURTHER DEVELOPMENT

Instead of a dowel, coats will be hung using the concept proposed in initial design 12.

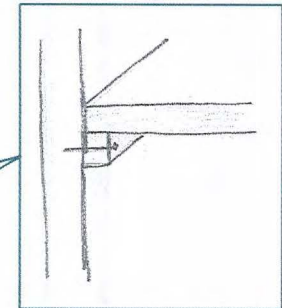
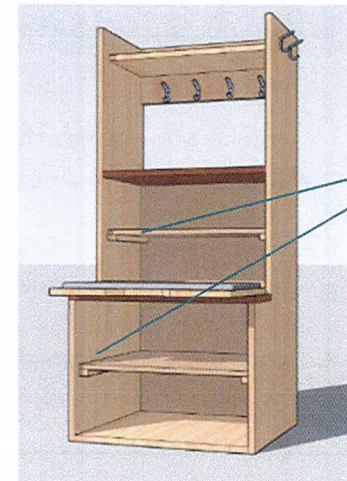
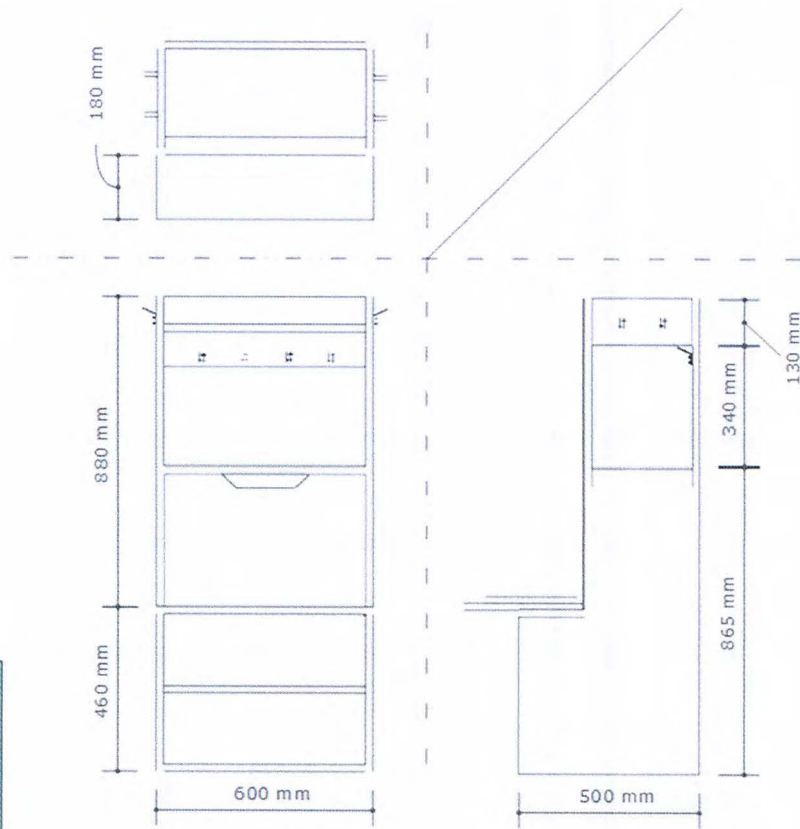


Possible Modification:
Aluminium bars instead of solid pine.

Using aluminium bars with holes drilled through and screwed into the pine will decrease weight while not sacrificing strength, and will offer a more varied appearance.



Hinges will be positioned on a raised plank of wood with countersunk slots to allow the seat to fold in and out.



Shelves have a wooden rail holding them from beneath; this allows them to be taken out to create double-height areas for boot storage.

Specification

1.1 My product will be made of timber and manufactured board – namely Radiata Pine, Yaka, and plywood.

2.2 The timber and boards used in the product must have a durable and aesthetically pleasing finish

2.1 My product must be able to store 15 pairs of shoes and slippers, and 1 pair of boots

2.2 My product must be able to hang 2 bags and 2 coats

2.3 There must be a seat to allow users to sit while putting on shoes

2.4 My product must have places to store small items such as keys

3.1 My product must store shoes in a compact manner, with little wasted space

3.2 My product must ensure all storage areas can easily have items placed and removed by the user

3.3 The seat of my product must allow the user to sit comfortably with ample space

3.4 The product must consist of a single, concise unit that saves space and is easily transported

4.1 My product will be made entirely of biodegradable or reusable materials

Reason

*Grey: Cannot be determined for certainty at this stage.

Design uses materials of timber and manufactured boards - Radiata Pine, Yaka, and plywood.

Timber and boards used will have a coat of varnish applied to enhance aesthetics and durability

Limited storage space due to unit's small size. May not reach the required storage quota.

4 dowels on the coat tree allow 2 bags and 2 coats to be hung.

Folding seat enables user to sit while putting on shoes

Yaka countertop provides space for small item storage

Shelves are arranged compactly, with minimal wasted space

All shelves are easily accessible and shoes can be quickly placed in or taken out of them

Seat is a little narrow, but has a comfortable padding and should be fine for short uses.

Unit is very compact and can fit in even the smallest entrances

Timbers and manufactured boards used in the unit are biodegradable, while metal screws, hinges etc. are recyclable

4.2 My product must be durable enough to withstand frequent user interaction and minor impacts from kicking, knocking, scratching

5.1 The cost of the materials for my product should range between \$130 - \$260 NZD

6.1 All parts of the product must be manufacturable in a school workshop, except the upholstered seat cushion, which, if implemented, can be sourced elsewhere

7.1 The product must have a simple, contemporary design to appeal to people living in urban areas as well as younger users

7.2 The product must fit compactly into a box and be assembled by the user in less than 30 minutes

8.1 The product's surface must be mainly natural wood, with certain areas being either painted white or with a dark wood varnish applied

8.2 At least half of the shoe storage areas must have doors or drawers to conceal stored items

8.3 the outer surface of the unit must have no more than 3 main colours to reflect a contemporary, minimalistic style

9.1 The maximum shelf or hook height must be no more 1700mm

9.2 Each drawer must have a handle or slot that is greater than 65mm in length, or a knob that is between 15mm – 40mm in radius

With the removal of the dowel tree, the product is much more durable and resistant to breakage. Its sturdy construction and Yaka surfaces prevent structural failure and scratching.

Cannot be determined for certainty at this stage.

The wooden parts of the unit and its construction methods can all be achieved in the workshop.

The design of the unit is simple and modern, with simple shapes and colours

Cannot be determined for certainty at this stage, but due to its small size and simplicity, this specification should be met easily

All surfaces which are exposed to view are natural wood. Yaka countertop has a dark varnish applied

All shelves have doors concealing stored items

The dark Yaka and the lighter pine are the only two colours visible

The highest hook is positioned at 1400mm height

All slots for opening the drawer door or the seat door are greater than 65mm in length

9.3 There must be a countertop to place small items at a height of around 110mm

10.1 The product's total dimensions must not exceed 1100W x 1800H x 650D (in mm)

10.2 The product must not weigh more than 30kg

10.3 The drawers or shelves for the shoes and slippers must have a minimum dimension of 280L x 240W x 100H

The drawers or shelves for boots must have a minimum dimension of 270L x 220W x 190H

10.4 There must be at least 820mm height below the clothes hooks

10.5 The seat must have a surface area and height of more than 400W x 320D x 450H.

11.1 The product must not have very sharp corners or edges

11.2 The seat must be able to support at least 90kg

11.3 The shelves for boots and shoes must be able to support at least 1.1kg

11.4 The hooks for bags and coats must support at least 3kg

11.5 The product must not wobble or tilt when pushed or seated on, and must not topple or fall over when a person moves it.

There is a countertop with a height of 100mm

The unit's total dimensions are 800W x 600D x 1500H

Cannot be determined for certainty at this stage, but its small size means it should easily be below 30kg

Shelves are more than 280L x 120W x 100H

Shelves are customizable to meet the dimensions required for boots

The highest clothes hook is 1400mm high, and the lowest is 1000mm.

The seat has a surface area and height of more than 400W x 320D x 450H

There are sharp corners and edges depicted in the drawings and models, but can be smoothed or rounded during manufacture

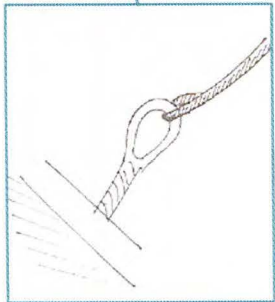
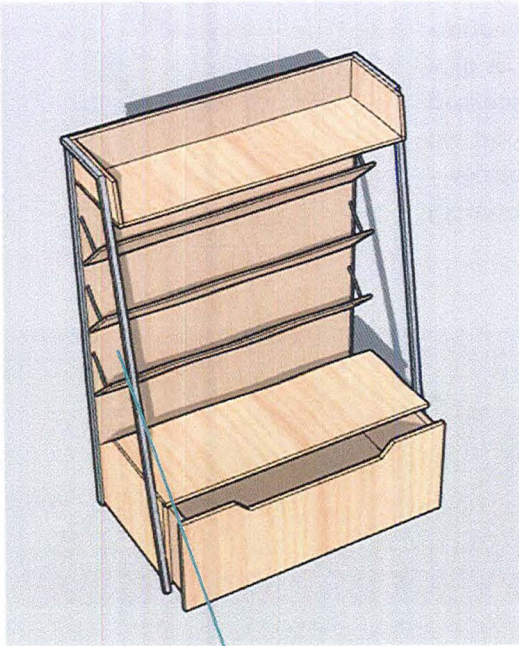
Cannot be determined for certainty at this stage.

Cannot be determined for certainty at this stage.

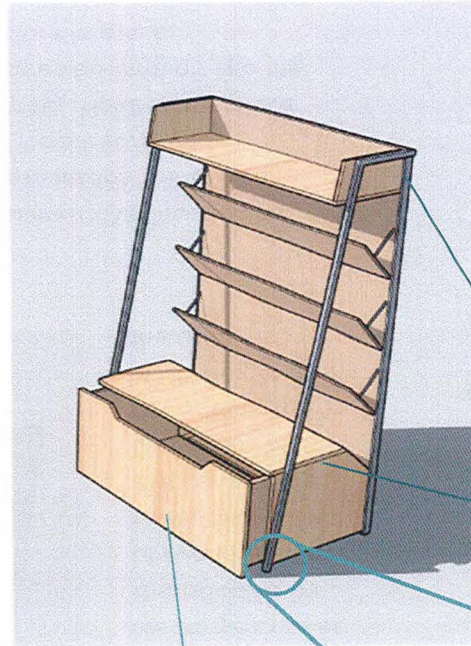
Cannot be determined for certainty at this stage.

The unit is very sturdy and squat, having a low center of mass which makes it very stable.

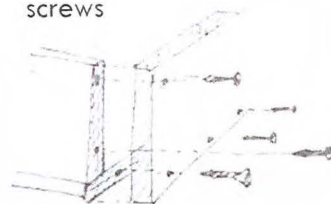
FURTHER DEVELOPMENT 3



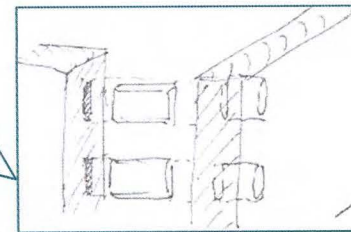
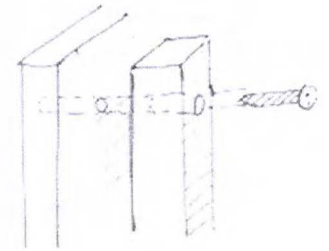
Small holes are drilled into shelf planks and back board, and rings are screwed into both holes. A wire is tied to both rings, and a hinge secures the bottom edge to the back board, which allows the shelves to hang suspended.



Front of drawer will be secured to bottom and sides of drawer with countersunk screws, after which a filler will be applied to hide the screws

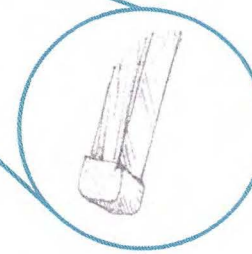


Hollow square aluminum rods welded to form a frame will hold up back board and top shelf, while also adding to the unit's aesthetics, making it appear more modern and balanced. The frame will have holes drilled through them and screws will secure it to the wooden parts of the unit

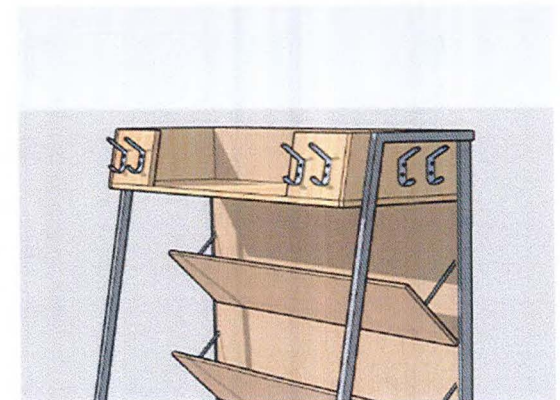


Domino joint made with domino cutter. Dominoes and wood glue secures pieces together. Simple to create and very strong.

Rubber caps prevent aluminium rods from scratching floors



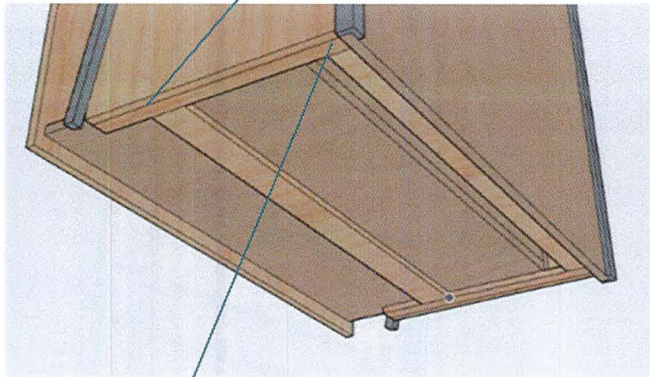
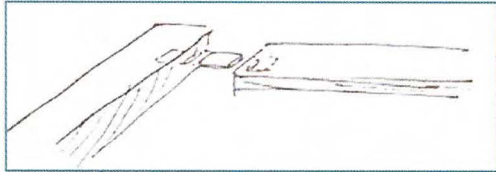
Developments



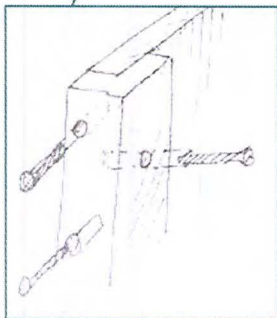
I added additional hooks on the front of the unit, allowing 8 items to be hung and not obstructing too much of the shelves and seat

Development and Orthographic Drawing

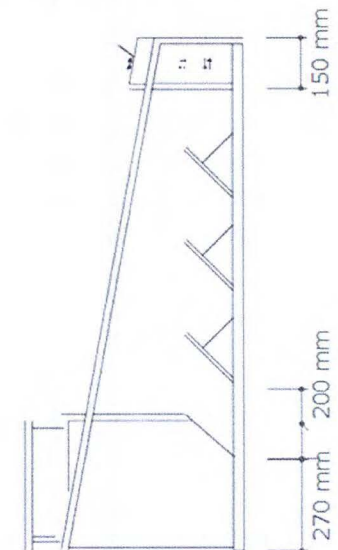
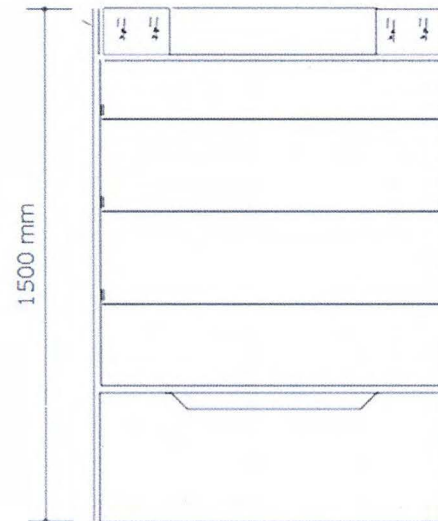
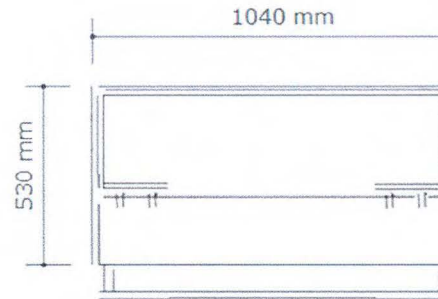
Domino joint made with domino cutter.
Dominoes and wood glue secures pieces
together. Simple to create and very strong.



The underside of
the large drawer
is supported by
plywood planks,
which allows the
drawer to slide
in and out while
not adding too
much weight to
the unit.



Externally sourced aluminium with L
- shaped cross-section will brace
the plywood backboard and
prevent warping. Holes in the piece
with screws screwed through into the
wood will hold it in place.



Specification

1.1 My product will be made of timber and manufactured board – namely Radiata Pine, Yaka, and plywood.

2.2 The timber and boards used in the product must have a durable and aesthetically pleasing finish

2.1 My product must be able to store 15 pairs of shoes and slippers, and 1 pair of boots

2.2 My product must be able to hang 2 bags and 2 coats

2.3 There must be a seat to allow users to sit while putting on shoes

2.4 My product must have places to store small items such as keys

3.1 My product must store shoes in a compact manner, with little wasted space

3.2 My product must ensure all storage areas can easily have items placed and removed by the user

3.3 The seat of my product must allow the user to sit comfortably with ample space

3.4 The product must consist of a single, concise unit that saves space and is easily transported

4.1 My product will be made entirely of biodegradable or reusable materials

Reason

*Grey: Cannot be determined for certainty at this stage.

Design uses materials of timber and manufactured boards - Radiata Pine, Yaka, and plywood.

Timber and boards used will have a coat of varnish applied to enhance aesthetics and durability

Product's large drawer and hanging shelves can store a large number shoes and boots, exceeding 16 pairs

8 hooks allow at least 2 bags and 2 coats to be hung.

A wide seat enables one or two users to sit while putting on shoes

There is no countertop to place items, however there is ample space on the seat for items to be temporarily placed. However, this may give the unit an untidy appearance

Bottom drawer is large and inefficient in storing shoes, with vertical space potentially wasted

Most shelves are easily accessible and shoes can be quickly placed in or taken out of them. The highest hanging shelves and top shelf may be harder to access

Seat is very wide, but lacks soft padding and may be uncomfortable is used for longer periods

Unit is rather large and quite bulky, with some empty, unused space, making it not concise and hard to transport

Timbers and manufactured boards used in the unit are biodegradable, while metal screws, hinges etc. are recyclable

4.2 My product must be durable enough to withstand frequent user interaction and minor impacts from kicking, knocking, scratching

5.1 The cost of the materials for my product should range between \$130 - \$260 NZD

6.1 All parts of the product must be manufacturable in a school workshop, except the upholstered seat cushion, which, if implemented, can be sourced elsewhere

7.1 The product must have a simple, contemporary design to appeal to people living in urban areas as well as younger users

7.2 The product must fit compactly into a box and be assembled by the user in less than 30 minutes

8.1 The product's surface must be mainly natural wood, with certain areas being either painted white or with a dark wood varnish applied

8.2 At least half of the shoe storage areas must have doors or drawers to conceal stored items

8.3 the outer surface of the unit must have no more than 3 main colours to reflect a contemporary, minimalistic style

9.1 The maximum shelf or hook height must be no more 1700mm

9.2 Each drawer must have a handle or slot that is greater than 65mm in length, or a knob that is between 15mm – 40mm in radius

The unit will be very durable and sturdy, provided the aluminium frame is welded securely

Cannot be determined for certainty at this stage.

While the wooden parts of the unit and its construction methods can all be achieved in the workshop, the aluminium rods need to be externally sourced

The design of the unit is simple and modern, with simple shapes and colours

Cannot be determined for certainty at this stage, but due to its large size, this specification may be challenging to meet

The aluminium frame means not all surfaces which are exposed to view are natural wood.

The suspended shelves are not covered, meaning potentially half or more of the shoes/slippers will be visible

The aluminium and pine are the only textures/colours visible

The highest hook is positioned at 1600mm height

All slots for opening the drawer door or the seat door are greater than 65mm in length

9.3 There must be a countertop to place small items at a height of around 110mm

10.1 The product's total dimensions must not exceed 1100W x 1800H x 650D (in mm)

10.2 The product must not weigh more than 30kg

10.3 The drawers or shelves for the shoes and slippers must have a minimum dimension of 280L x 240W x 100H

The drawers or shelves for boots must have a minimum dimension of 270L x 220W x 190H

10.4 There must be at least 820mm height below the clothes hooks

10.5 The seat must have a surface area and height of more than 400W x 320D x 450H.

11.1 The product must not have very sharp corners or edges

11.2 The seat must be able to support at least 90kg

11.3 The shelves for boots and shoes must be able to support at least 1.1kg

11.4 The hooks for bags and coats must support at least 3kg

11.5 The product must not wobble or tilt when pushed or seated on, and must not topple or fall over when a person moves it.

There is no countertop to place items

The unit's total dimensions are 1040W x 530D x 1500H

Cannot be determined for certainty at this stage, but its large size and bulk means it may exceed 30kg

Shelves and drawer are more than 280L x 120W x 100H

Drawer is much larger than the minimum dimension of 270L x 220W x 190H

The highest clothes hook is 1600mm high

The seat has a surface area and height of more than 400W x 320D x 450H

There are sharp corners and edges depicted in the drawings and models, but can be smoothed or rounded during manufacture

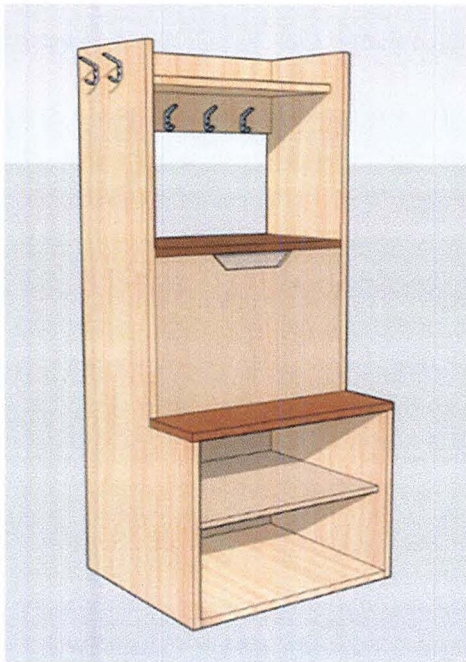
Cannot be determined for certainty at this stage.

Cannot be determined for certainty at this stage.

Cannot be determined for certainty at this stage.

The unit is very sturdy and squat, having a low center of mass which makes it very stable.

CHOSEN DESIGN FOR FURTHER TESTING/MODELLING

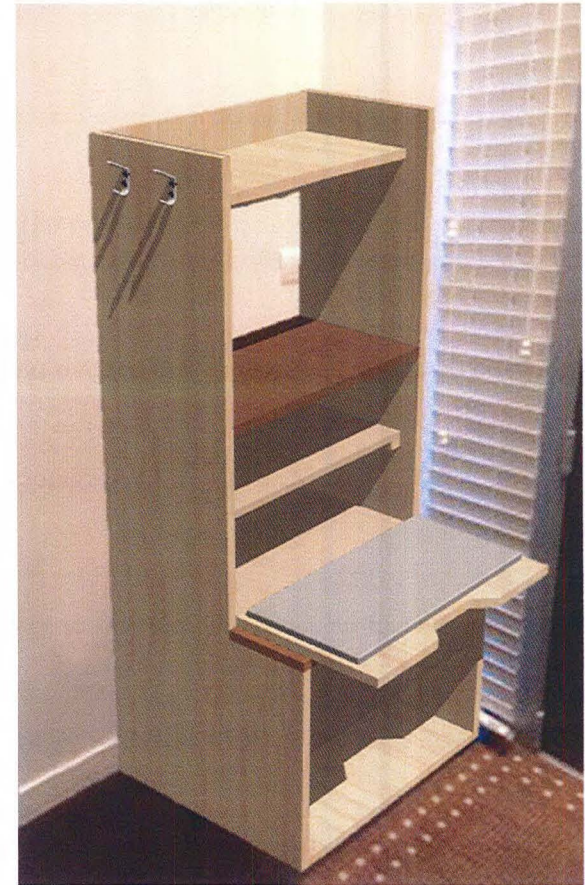


Developed Idea 2

This unit meets all my specifications, and combines the desirable aspects of multiple designs. It is simple and effective, and does not have many complex components.

To test this concept, I will laser cut it and assemble a scale model, then make full size mock-ups in the workshop of certain components such as the seat to evaluate its ergonomics and strength, as well as the hook board and shelves to test their structural integrity and fitness of purpose.

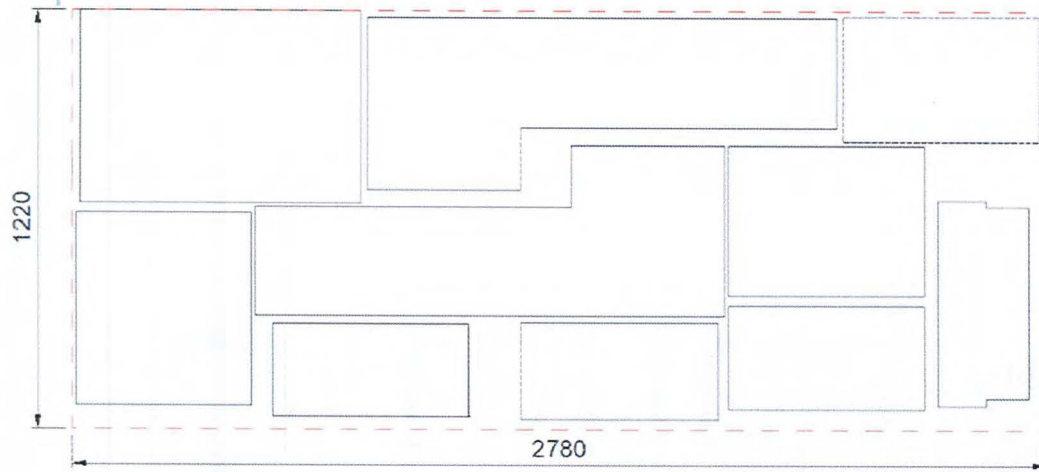
Render of the product placed in my client's entrance



Criterion 4

MATERIAL PRICE ESTIMATION – MAIN BODY OF PRODUCT

Material Option: RADIATA PINE



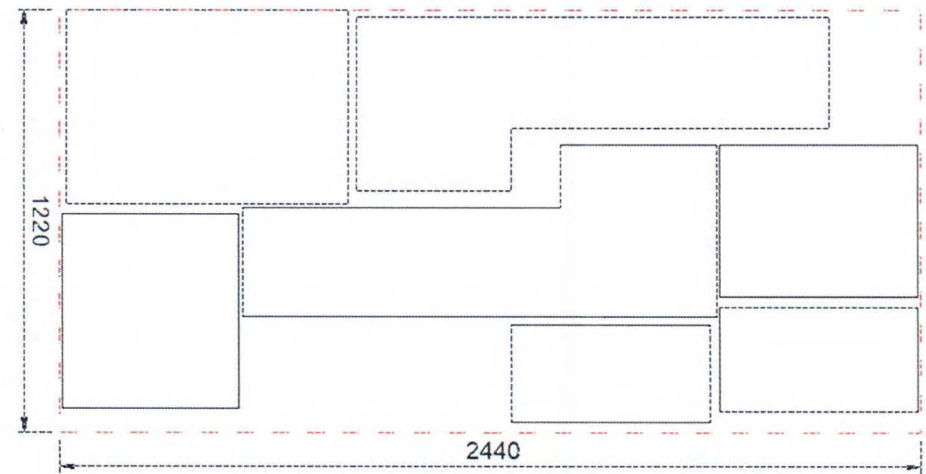
Pine planks will be glued together to form a 1.22m x 2.78m board, onto which the different components of the unit will be drawn onto and cut.

Price:

A 150mm wide x 25mm thick plank costs \$7 per l/m.

Nine 2.44m planks are needed to form the board, making the cost total to \$140.

Material Option: PLYWOOD ✓



18mm Plyman Lite Birch

2440 x 1220

\$119.55 incl GST

This product has 2 clean BB faces with a Paulownia core allowing you to easily handle this thick plywood whether it's below or above your head.

Also available in 9mm/12mm

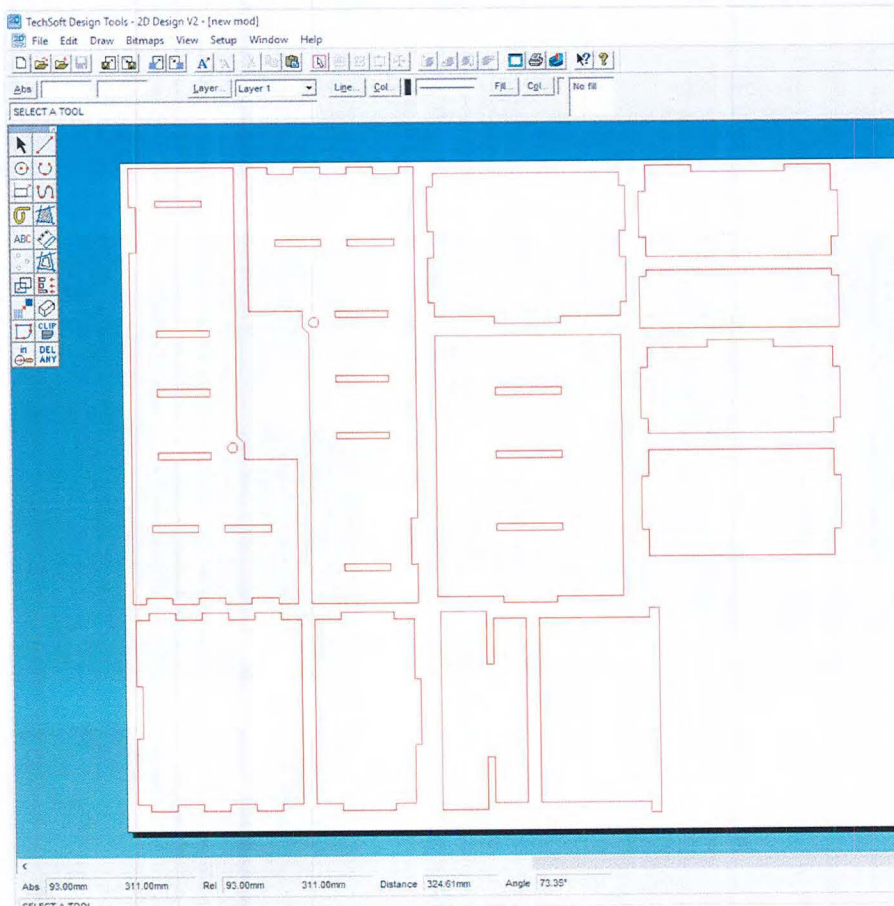


Plywood offers a much easier and slightly cheaper alternative to pine – all main components of the unit can be cut from a single board.

The surface will also have a smoother appearance, and can be varnished to give a nice wood appearance.

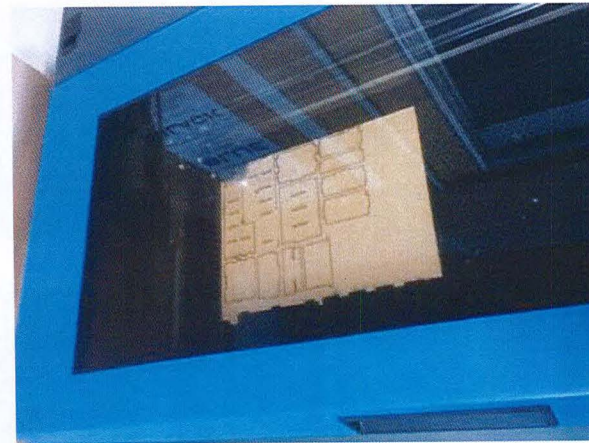
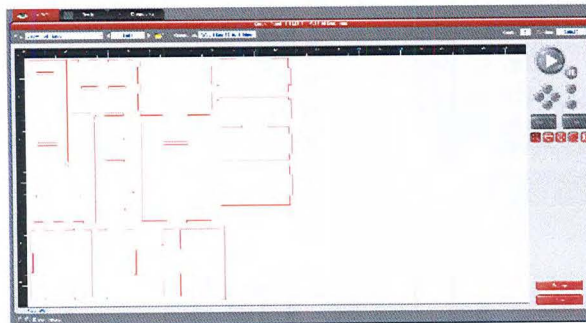
I will thus choose plywood as my main material.

MODELLING – SCALE MODEL



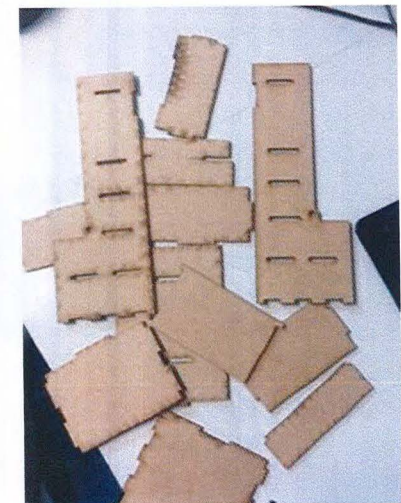
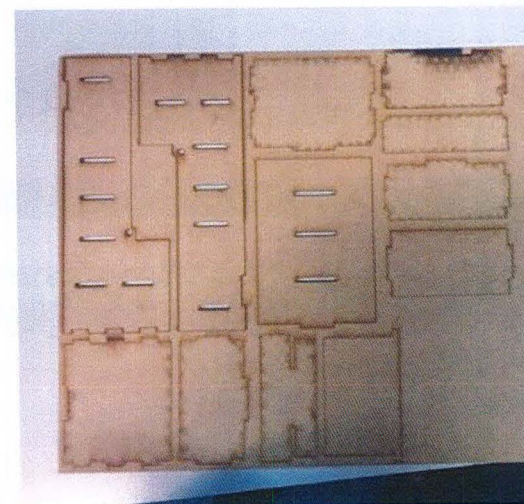
Scale: 10 : 1.5

The design was cut on 3mm MDF using the laser cutter.



Using a 1 : 0.15 scale, I created the individual parts of my product on 2D Design, and added joint designs on different pieces, mostly in the form of slots and holes.

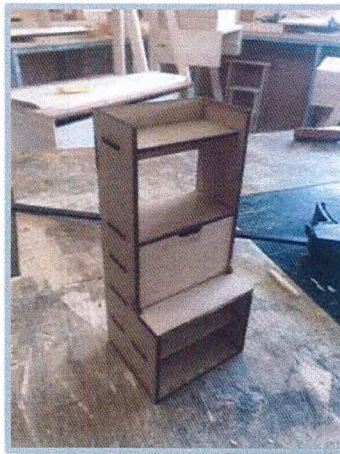
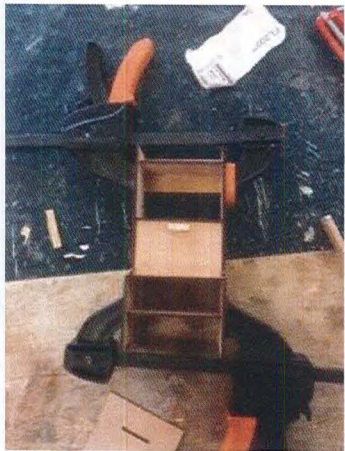
While this is not representative of the actual methods of joining that will be used, it does provide an idea of the way in which parts are connected to each other, as well as produce a more sturdy model.



MODELLING – SCALE MODEL



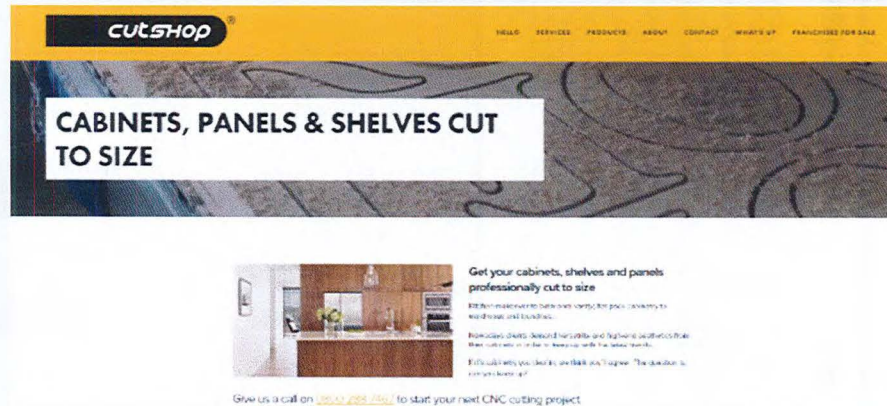
Gluing and sanding down the assembled model. The pieces fitted together very nicely and easily. The seat also slots into the side pieces so it can rotate and be opened or closed.



ANALYSIS

The scale model turned out very successfully, and has given me a clear idea of what the product will look like and how it will function.

It has also allowed me to consider the number of components I will need to produce and the size and shape of each component. I can thus consider what construction processes I will use, as well as which materials would be appropriate.

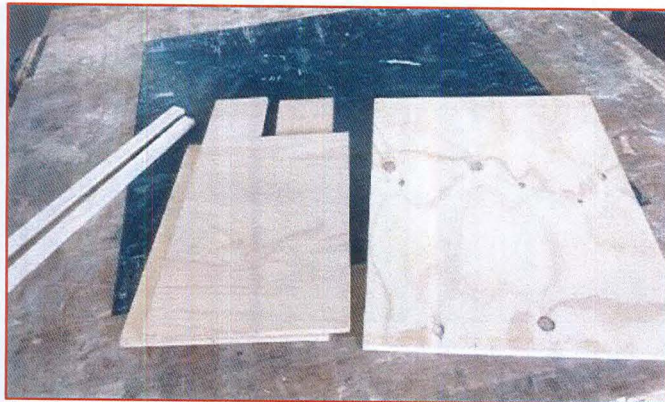
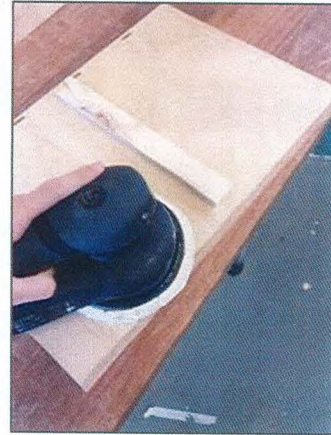
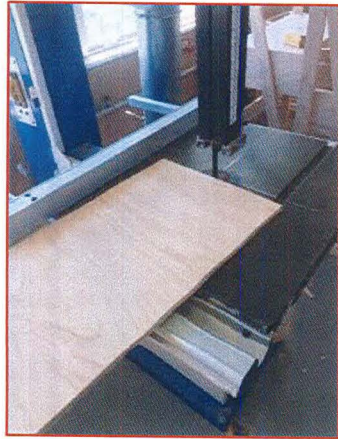


I could consider having my main shelf components cut out of plywood or another material by requesting a custom order at a professional CNC cutting servicer. This will ensure precise cuts and also save time.



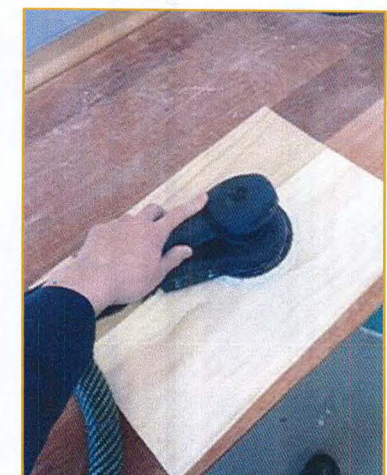
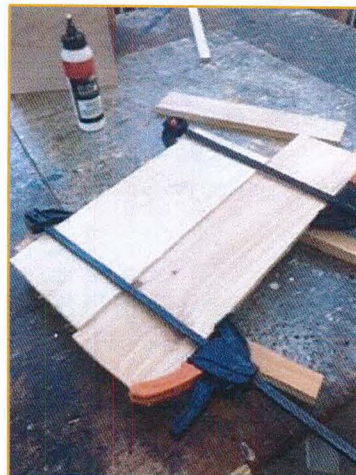
MODELLING – BOTTOM HALF OF UNIT

Cutting plywood into individual components that form the bottom half of the product using band saw.



I then obtained two pine planks, which I butt joined and glued together, then smoothed the surface using the thicknesser, and cut it to size with the band saw. I glued this to the shelf top.

Using the domino, cutter, I cut 7mm high slots into the side of the back board and side boards, allowing me to join the pieces together. Finally, the orbital sander was used to smooth out the surface. The joint created was very strong and rigid, and the entire process was quite straightforward and simple.



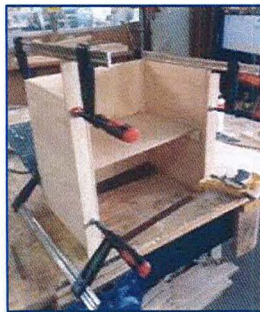
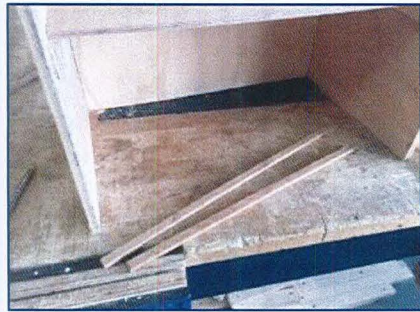
MODELLING – BOTTOM HALF OF UNIT



A negative aspect of plywood is its unsightly edge, which is not smooth but consists of many layers. I wanted to hide this edge, and to make the plywood look like natural timber was much as possible.

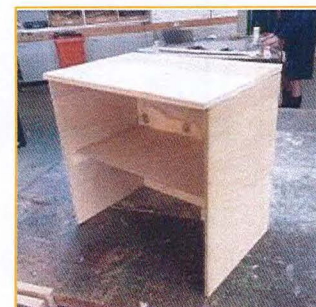
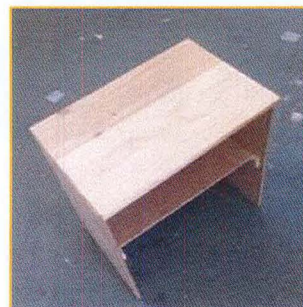
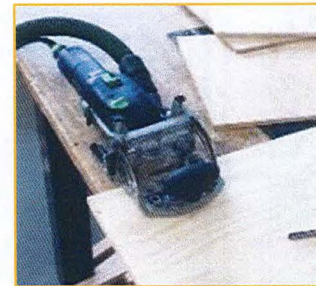
I thus used two strips of Salu Salu, which had been cut to the exact length and width of the edge of the plywood, and glued them onto the edge.

After sanding, the result was very pleasing and aesthetics were greatly improved.



To join the seat to the rest of the unit, I used the domino cutter to create slots in the top edge of the main unit, as well as the underside of the seat. Doing this allowed me to insert dominos, and with glue, create a strong and durable bond.

I used the orbital sander to smooth out the entire unit and eliminate scratch marks. The final result was very aesthetically pleasing, as well as structurally sound.



ANALYSIS

The outcome of the mock-up has been very successful, and has allowed me to test the effectiveness and appropriateness of my construction methods.

The model, with its plywood sides, Pine seat, and Salu Salu edge stripping, has also enabled me to have a more accurate idea of what the final outcome will look like, especially in terms of materials, aesthetics and colour combination.

Moreover, the model will allow me to run ergonomic, functional, structural and durability tests to ensure the design performs as intended prior to final modelling.