Year 11

Product Design Folio

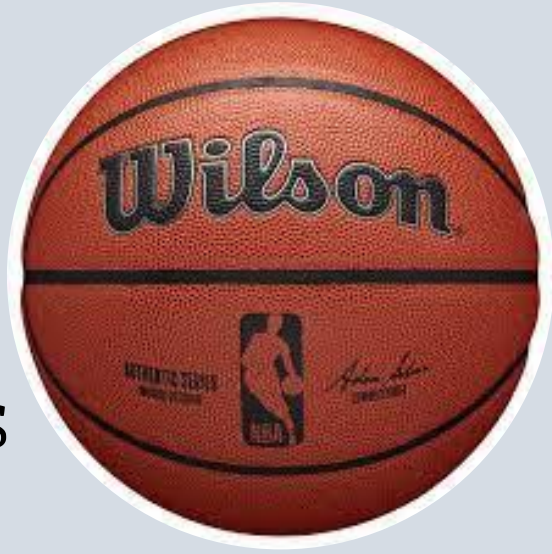
Bavreet Ubhi

SPECIAL THANKS TO: KT, MATT, DEANO

Table of Contents

DESIGN BRIEF

End Use Profile



The end user of the workbench is a 16-year-old male, he goes to school at the Geelong college and lives in Highton, he loves sports like basketball and building items out of wood. He has a mum who works at NDIS as a project manager and a dad who runs his own cleaning business, he has 1 brother who is 9 years old. He has tools lying around the floor because he hasn't got any place to put his tools and equipment. He is a student with a stable income due to him working at a café and as a cleaner. he enjoys playing games on his pc, going out with friends, working out and creating things. He doesn't have a favourite colour, but likes the look of dark timber contrasting with light timber

DESIGN BRIEF

Outline of problem

My end user loves to create items out of wood and other materials, he has plenty of tools but no place to store them in the garage because there aren't any spare draws or shelfs. He needs there to be plenty of storage and a large area to build stuff on top, it should have a magnetic tray to put screws and other metal things when he opens electronic, a built-in light and PowerPoint which can be retracted to protect it from damage. it must be portable because he will need to move it when he moves house. It needs to be sturdy enough to handle all possible damage and have a removable tabletop so if damaged it can be replaced. He needs it to look clean and modern to fit in with the rest of the garage. To solve the problems addressed the workbench will be fitted with extra supports on both sides to reduce break points as well as this It will be fitted with wheels for moveability and portability.

Specifications

The work bench will be roughly 2000mm long, have a width of 800mm and a height of 900mm, the plan is for it to be made from a cheap and lightweight resource such as pine. It will have shelves which will be made 25mm thick pieces of wood and each shelf will be fitted with a handle or a cut-out depending on the shelf will contain. It will have a large tabletop which will hang over the base by about an 25mm on all sides, the corners will be curved to prevent hazards. The edges of the table will come up about an 25mm to provide enough space for a piece if MFD to fit in between the boarders and work as a table-top

DESIGN BRIEF

Constraints and consideration:

Constraints:

- The Must be sturdy enough not to get damaged by the tools
- Must me movable so it can move to different locations
- Must have a replaceable tabletop
- Must be sustainable made
- Must fit well in the garage
- The budget cannot exceed $500

Considerations:

- Should incorporate a sturdy light
- Should have a built-in magnetic tray
- Try to complete project before the exams
- Keep quality precision of pieces to ±5 mm
- Should look good

Primary and secondary function:

Primary function:

The primary function of the workbench is to be used as a surface for working at, eating from or on which to place things.

Secondary function:

Secondary functions of the workbench are the legs, tabletop, supports, vice, draws and shelfs.

Design priority

DESIGN BRIEF

- Must be sturdy enough not to get damaged by the tools

The primary constraint is the workbench not getting damaged by tools when being used, it must be sturdy enough to be able to handle Hamer strikes and sudden impacts by other tools.

Product design factors

Factor:	How it effects the project:
Purpose, function, and context	The purpose of the workbench will be to support the use of tools and to be able to store and protect them from getting damaged. The primary function of the workbench will be to hold items when being worked on, the major function will be supported by having a large tabletop, plenty of draws/shelfs. The bench will be placed in the garage where it can be placed next to a wall when not in use
User-centred design	The user needs the workbench to be able to fit in the garage, it needs to capable of moving around freely and be at the right height the user can be productive for long periods of time when using the workbench. The workbench is required because the user doesn't have a proper workspace to work on when constructing and working on items, it will also be used to store tools when they are not in use, the reason for not buying one is because most other workbenches aren't as customisable and usually are mass build and not from a sustainable source. To keep the workbench as safe as possible it will have rounded corners and be sanded down.

Product design factors (continued)

DESIGN BRIEF

Innovation and creativity	The work bench will have multiple features to keep it innovative from other benches, such as a built-in retractable lamp to allow for working in dark environments, some other examples are the magnetic tray to hold small items or built-in power-points for powering the tools when on top of the table,
Visual, tactile, and aesthetic (Design principles and elements)	The workbench will have a smooth texture for the table-top, the workbench will have an asymmetric shape for the shelves and draws, it will have a basic rectangular table shape.
Sustainability	The workbench must be environmentally sustainable, the pine will be sourced from a certified supplier, I will consider using recycled materials for some parts of the workbench.
Materials	The materials should be able to survive an extended period and capable of resisting damage from hand and power tools, it needs to be cheap but durable and sustainably sourced to reduce the environmental impact,
Technologies (Tools and manufacturing methods)	The table will use Mortise and Tenon Woodworking Joints due to their strength and sturdiness it will also use glue, nails, and screws to keep everything together.

DESIGN BRIEF

No.	Evaluation criteria	justification	Ways to achieve this	Checking Method on final Product
1.	will the workbench be sturdy enough to handle damage and not get damaged?	If it is not strong enough to handle the impacts and damage it won't serve any purpose, there wouldn't be any point of having it.	To make sure the workbench won't get damaged I will make sure to use adequate joint methods as well as.	- Actually use the workbench, put weight on it and fully use it
2.	Is the workbench portable?	Due to the user doing a wide array of projects he will need to be able to move the location of the workbench so he will have an optimal position to work.	The workbench will have wheels on the bottom to provide manoeuvrability, as well as wheels it will have lightweight design.	- Try moving it around with and without others - Test the castors leveling
3.	Is the tabletop going to be interchangeable?	A replaceable tabletop will allow for a new top to simply be placed on top and locked in place, this will allow for rapid repair and cheaper maintenance.	The tabletop will simply be placed on top and locked in place with a built-in mechanism to remove any movement.	- Try removing the top and adding something else to check level - Confirm the tabletop comes off easy

DESIGN BRIEF

4.	Will the workbench be sustainable?	Important to use material from a sustainable source as it will be better from the environment.	Wood will be scored from certified suppliers. As well as attempting to use recycled materials	- Look at amount of wastage - See how much it cost in time and labour
5.	Does the workbench fit in the garage	For ease of use the workbench will be in the garage where there is easy access to electricity, water, and the tools.	The garage will be measured to see what size workbench would fit best.	- Measure it up -

Quality statement

My workbench will be ergonomically designed to allow for extended periods of time, it will have rounded corners and a fully sanded surface. It will be made to the correct measurements (+) or (-) 5 mm and all joints will be correctly fitted and very strong.

INSPIRATION

Mood Board

INSPIRATION

Extended Product Annotations

The MDF tabletop fits into a notch created by the side pieces allowing for a snug fit, and a hole at the underside for when the MDF needs to be replaced when damaged.

- The replaceable table-top looks great and provides great functionality.
- it will allow for the centre MDF to pop out and be replaced if damaged
- the curved corners and edges will look great and will be much safer compared to its sharp counterpart

This workbench contains multiple draws to allow for tools to be sorted without being damaged, this will prevent the surroundings to get damages.

- Glass/ acrylic panels so you can see inside for easy accessibility
- The separate sized draws will allow for items of separate sizes to be stored easily
- The side mounted plugs will allow for easy use as well as the plugs not getting damaged

Most workbenches will have some sort of wheels to allow for it to move around freely, these castors will allow for the workbench to be lifted and lower without hustle.

- The castors will allow for easy movement
- As well as movement the castors can lock into place and lock the table
- Having free moving wheels will make turning the table extremely easy

INSPIRATION

Extended Product Annotations (continued)

Ply or pine are great candidates to make the structure of the table from this is due to their strength and water resistance, especially if you buy marine grade or structural grade.

- The ply and pine can be easily painted to allowing for it to be any colour
- Ply has a high structural strength, especially if you buy anything above structural grade
- Pine is extremely cheap compared to other woods meaning it would be inexpensive to make

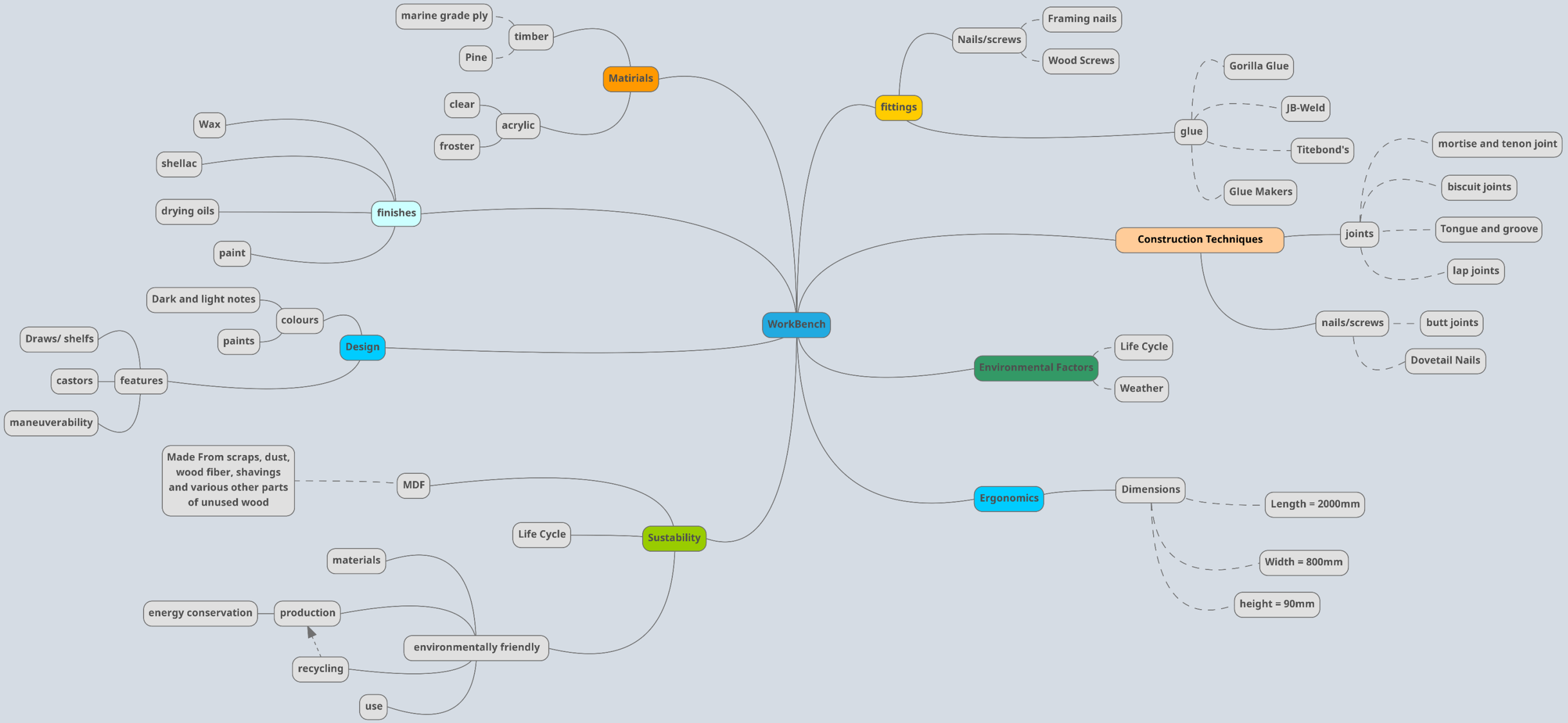
Painting or oiling the wood a different tone would make for a great finish.

- The dark colour contrasts the lighter colour making for a good tone
- the darker stain or oil would allow for the wood grain to be visible and provide an aesthetically pleasing surface
- the lighter toned would look great in a darker garage, and contrast well with a darker MDF top

The foldable side table will give the extra required space provide a pace to put stuff when the rest of the table is in use.

- When the table-top runs out of space the side table can be pulled out and used as extra space
- The extended table-top size would allow for larger pieces of wood to be placed on top and worked on
- The foldable table-top design will allow for the table to fit in and through smaller spaces, but it

MIND MAP


WorkBench
Matirials
timber
marine grade ply
Pine
acrylic
clear
froster
finishes
Wax
shellac
drying oils
paint
Design
colours
Dark and light notes
paints
features
Draws/ shelfs
castors
maneuverability
Sustability
MDF
Made From scraps, dust, wood fiber, shavings and various other parts of unused wood
Life Cycle
materials
production
energy conservation
environmentally friendly
recycling
use
fittings
Nails/screws
Framing nails
Wood Screws
glue
Gorilla Glue
JB-Weld
Titebond's
Glue Makers
Construction Techniques
joints
mortise and tenon joint
biscuit joints
Tongue and groove
lap joints
nails/screws
butt joints
Dovetail Nails
Environmental Factors
Life Cycle
Weather
Ergonomics
Dimensions
Length = 2000mm
Width = 800mm
height = 90mm

RESEARCH

Research table

Product	Image	Research
Building materials		
Marine Ply		Marine plywood is specifically designed with structural strength for greater impact resistance as well as to absorb the effects of water movement and pressure Whilst marine plywood isn't waterproof, it's a type of plywood which can deal with moisture. Contrary to what you'd expect, marine plywood is not in itself waterproof but rather a quality plywood made with waterproof glue.
Pinewood		Pine is a type of softwood and unlike hardwoods, pine trees grow all around the world. Tough this is a softwood, it has a great deal of stiffness and resistance to shock. This property of pine wood make is a favourable option for furniture making. Unlike hardwoods, pine is easier to work with due to its soft nature. There are many

RESEARCH

Research table

Pinewood (continued)		pros of pine wood which make it perfect for contemporary furniture making and this the reason behind the prevalence of pine furniture.
MDF		Medium Density Fibreboard (MDF) is a reconstituted wood panel product. It is a dry-processed fibreboard manufactured from wood fibres, as opposed to veneers or particles, and is denser than plywood and particleboard. MDF has an even density throughout and is smooth on both sides. MDF is reconstituted into wood sheets in a variety of widths and lengths. Bonding is achieved by the addition of synthetic resin adhesives, which are cured under heat and pressure. Paraffin wax is added to assist with water repellence,
Finishes		
Wax		Deemed the ‘classic’ finish, waxes have been used for centuries to enhance wooden furniture and provide wood protection against stains. Made from

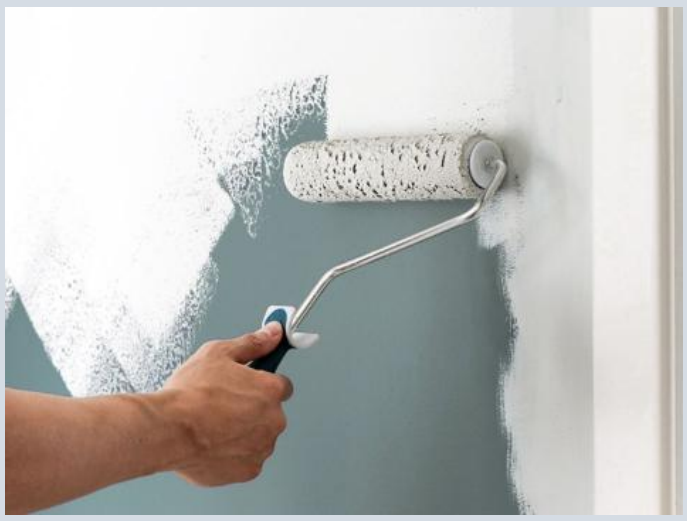
RESEARCH

Research table

Wax (continued)		natural ingredients, they produce a soft, satin sheen and give furniture a silky feel. The benefits of wax finishes: can be applied directly onto bare wood can be used over French polish, varnish, or oil to create an extra protective barrier easy to repair and maintain, simply
Shellac		Shellac is a warm coloured finish for wood that's easy to apply with a rag, brush, or sprayer. It dries quickly so multiple coats can be applied in one day. It is a natural finish that has been used for thousands of years. The colour of shellac ranges from garnet to clear and it enhances the natural beauty of wood.

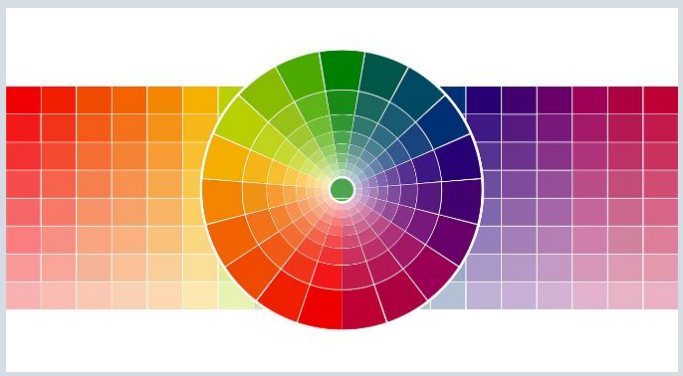
RESEARCH

Research table

Drying oils		Exquisite products like solid wood furniture require protection that fulfills both protective and aesthetic demands. Surface treatments provide manifold ways to add such values to solid wood products: widespread, well-known finishes like paints, varnishes, stains, or oils [1,2], as well as modern approaches to render wood superhydrophobic or resistant to UV and biological decay [[3], [4], [5]]. In recent years, increasing awareness is shifting the main demand to more environmentally friendly systems, e.g., from solvent-to water-based or from biocidal to non-biocidal wood finishes
Paint		Paint is a mixture of four basic ingredients: pigments, resins, solvents, and additives. Pigment is the colour, and resin is the binder, or glue. Solvent is the carrier that makes it all liquid and evaporates as the

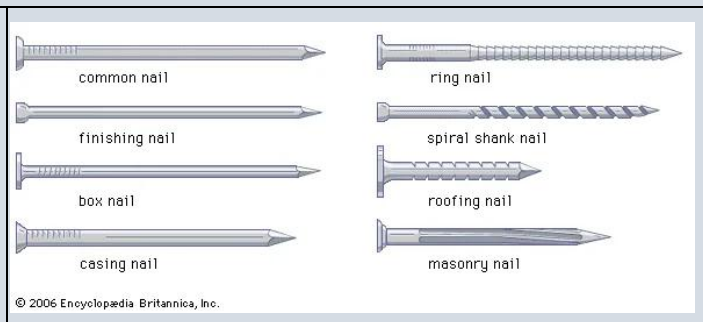
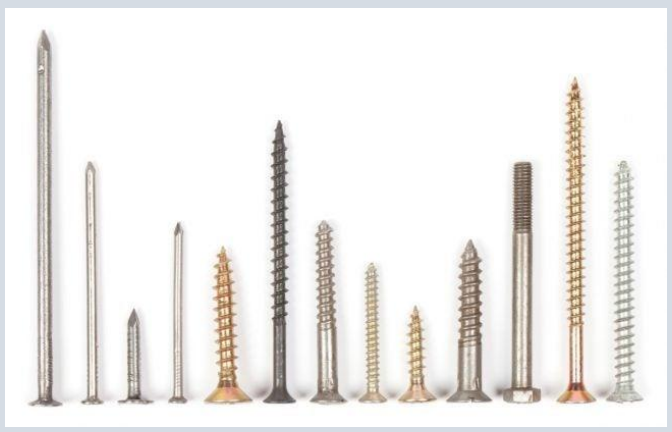
RESEARCH

Research table

Paint (continued)		paint dries. Additives provide specific performance characteristics, such as stain-blocking or mild killing properties.
Design		
Colours		Colour tables provide the mechanism to colorize a range of values. They consist of a table of values and associated RGB (red, green, blue) colours. Two successive values in the table define a range
Castors		The caster uses an anti-vibration pad to secure it to the floor. Once the pad is lowered, the application will not move. Unlike a locked swivel caster, the pad won't wobble and will remain stable. Leveling casters also have a lower profile to help keep the application close to its original overall height. The wheel is made of hard nylon and won't mark or scrape flooring. The die-cast aluminium fork allows it to carry extremely heavy objects up to a tonne.

RESEARCH

Research table

Fittings and glue		
Fitting Nails		Nails offer several subtle advantages over screws. For delicate work on small sections of wood that might be prone to splitting, nails can often do the job without damaging the wood.
Wood screws		When you choose screws, you get a mechanical advantage in the process. Driving in a screw uses less energy when compared to hammering in a nail into the same material. So, for those using hand tools, then the project instantaneously easier when screws are used. And the same goes for the use of power tools, which require less force and place less strain on the tool's motor. Screws are very strong and are built to last. This is a stark contrast to nails, which may come loose over time. This happens when the materials they connect with begin to expand and shrink over time. Screws are built

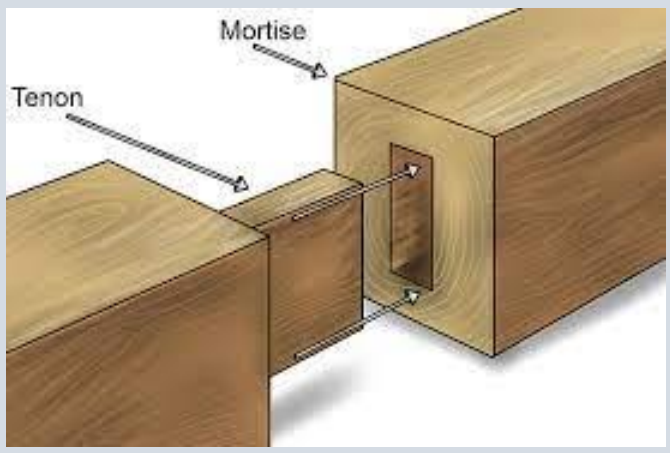
RESEARCH

Research table

Wood screws (continued		to resist this problem. Their hold is longer-lasting and stronger. And since screws are so strong, there is less of a worry about the durability and hold. So, it gives the material more of a piece of mind when done.
Gorilla Glue		Gorilla Glue is an American brand of polyurethane adhesives. They are known for their original Gorilla Glue, which was first sold in 1994. The company has since branched out to make a line of similar products, including tapes, epoxies, and other adhesives. The company is based in Sharonville, Ohio.
JB-Weld		Adhesive quality is higher Two-part epoxy. Sticks strongly to the material and on the surface, it's used on. JB Weld can be used on metal, plastic, PVC, wood, concrete, ceramic, tile, fibre, glass, toys, etc. Price is higher. But it's worth the price you'll be paying

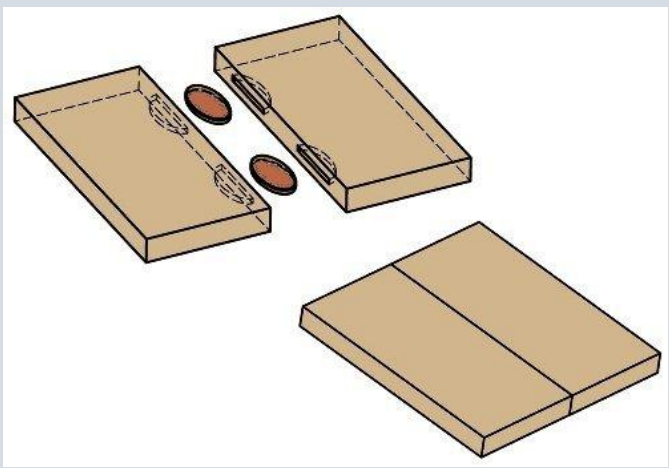
RESEARCH

Research table

Titebond's		Superior performance and product innovation over 75 years, trusted by professionals Excellent creep resistance Superior solvent resistance Excellent bond strength Excellent resistance to heat Available in varying speeds of set Excess glue will not clog your abrasive belts
Construction Techniques		
Mortise and tenon joint		The mortise and tenon joint have been used for thousands of years by woodworkers in their woodworking projects around the world to join pieces of lumber, mainly when the adjoining pieces connect at an angle of 90°. In its basic form it is both simple and strong. Although there are many joint variations, the basic mortise

RESEARCH

Research table

Mortise and tenon joint (continued)		and tenon comprises two components: the mortise hole and the tenon tongue. The tenon, formed on the end of a member generally referred to as a rail, is inserted into a square or rectangular hole cut into the corresponding member. The tenon is cut to fit together with the mortise hole exactly and usually has shoulders that seat when the joint fully enters the mortise hole.
Biscuits joint		Because biscuit joints are easy to mark out and quick to cut, using one almost seems like cheating. In truth, biscuits may not be as strong as some traditional types of joinery and may not be suitable for heavy-duty loads, but they're perfect for plenty of projects. Woodworkers and carpenters have been employing biscuits to successfully solve all sorts of assembly and alignment

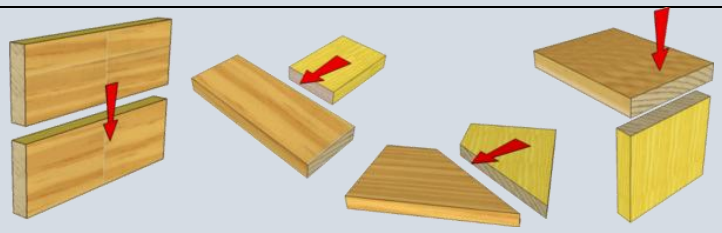
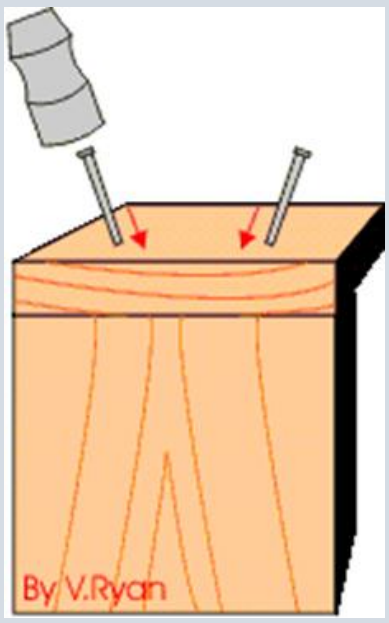
RESEARCH

Research table

		problems for over two decades.
Tongue and groove joint		Tongue and groove is a method of fitting similar objects together, edge to edge, used mainly with wood, in flooring, parquetry, panelling, and similar constructions. Tongue and groove joints allow two flat pieces to be joined strongly together to make a single flat surface.
Lap joint		When making furniture or woodworking projects, you often need to get pieces of wood to join together. This can certainly be done with screws and glue, but a more time tested (and honoured) method is to use Joinery. Joinery is the process of making interlocking parts with the pieces of wood and fitting them together like a puzzle.

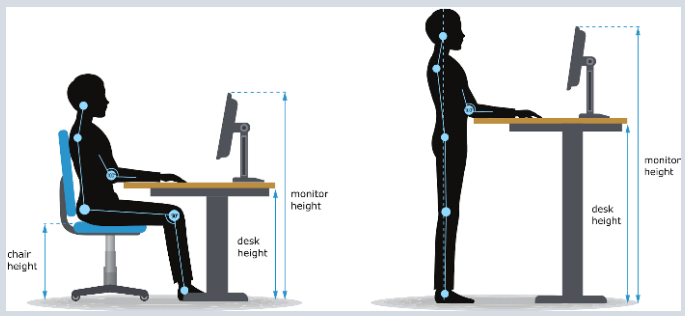
RESEARCH

Research table

Butt Joint		A Butt Joint is a simple coming together of two edges or faces. The joints can be fixed by simply gluing but more often is reinforced or strengthened before doing so. Butt Joints can be used to widen boards, make frames, and create carcasses.
Dovetail Nails		This is a simple way of strengthening any butt joint. All you do is grip the upright piece in a vice or the jaws of a portable workbench and glue the horizontal piece on top if it - supporting it with scrap wood to hold the joint square - and then drive in the nails dovetail fashion. The dovetail joint will be extremely strong and is resistant to pulling apart. This is because after it has been glued there are pins and tails that are trapezoidal shaped that take on a permanent hold. There will be no need for nails. This type of joint may be too hard for a beginner, as it needs precision cutting.

RESEARCH

Research table

Ergonomics		
Dimensions		The height of a workbench used in the sitting position should be between 680mm to 720mm above the floor. The typical minimum depth is 600mm. The standing height workbench may also be used for seated activities. In this circumstance, ideally the work bench would be height adjustable.

Sustainability

Factoring in social/ economic, environmental factors the product will be made with the emphasis of sustainability, trying to reduce the amount of waste produced. To be socially sustainable the work bench will address the needs and considerations of people such as safety and health, Similarly the requirements and considerations to keep the environment maintained will be followed including not polluting the air, water, and land. Only using up as much resources as required, sourcing materials from a reputable location which promotes sustainable gathering, conserving, and recycling leftover materials for later use and reducing the impact of materials that are disposed of moreover reduce pollution from the tools. Furthermore, the life cycle assessment will account for these factors and further try to reduce pollution and waste.

DESIGN OPTIONS

Option 1:

No.	Evaluation criteria	score
1	will the workbench be sturdy enough to handle damage and not get damaged?	5/5
2	Is the workbench portable?	4/5
3	Is the tabletop going to be interchangeable?	5/5
4	Will the workbench be sustainable?	4/5
5	Does the workbench fit in the garage	5/5
total		23/25

DESIGN OPTIONS

Option 2:

No.	Evaluation criteria	score
1	will the workbench be sturdy enough to handle damage and not get damaged?	3/5
2	Is the workbench portable?	3/5
3	Is the tabletop going to be interchangeable?	3/5
4	Will the workbench be sustainable?	3/5
5	Does the workbench fit in the garage	5/5
total		17/25

DESIGN OPTIONS

Option 3:

No.	Evaluation criteria	score
1	will the workbench be sturdy enough to handle damage and not get damaged?	3/5
2	Is the workbench portable?	4/5
3	Is the tabletop going to be interchangeable?	4/5
4	Will the workbench be sustainable?	3/5
5	Does the workbench fit in the garage	5/5
total		19/25

PREFERRED OPTION

Justification:

Hardwood outside which can be removed after extensive wear and tare to reduce environmental impact

Cut out handle to easily let the user take out the drawers for use

MDF top which can be removed and replaced as requested by the end user

Use of a dark hardwood will contrast with the light-colored pine for an aesthetically pleasing combination

Drawers of multiple sizes which were requested by the end user

Drawers have sliders to allow for ease of use for the user

Made of pine wood to reduce waste and keep costs down

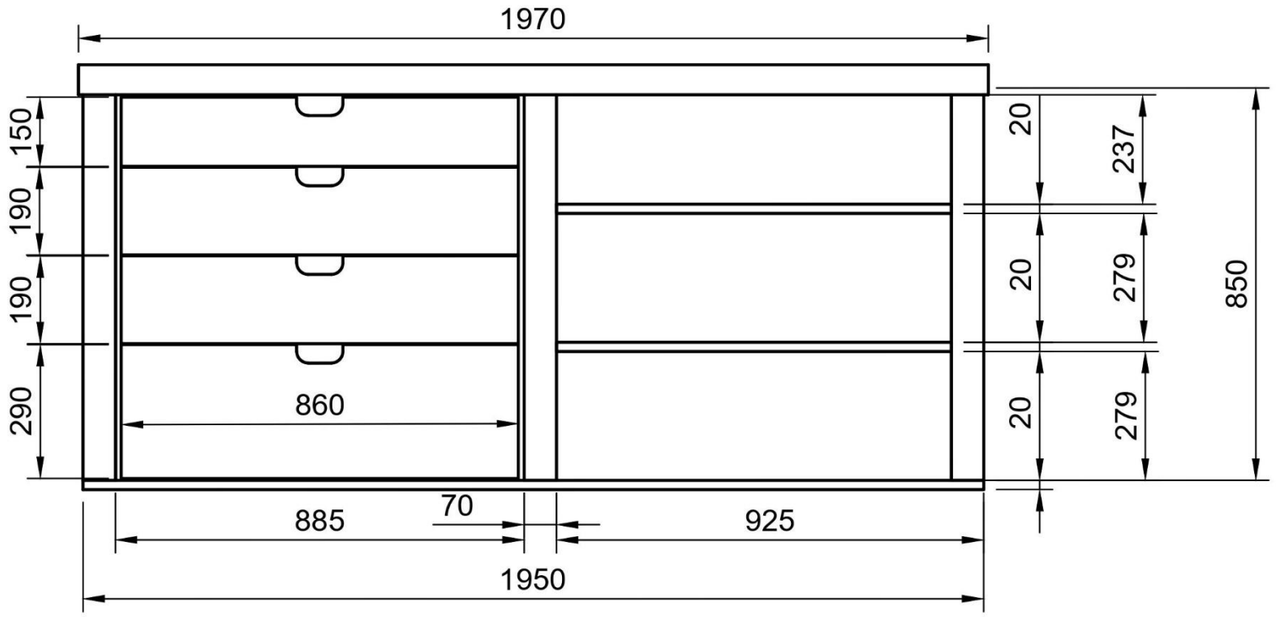
Shelfs supported by a support plank of timber and dowl

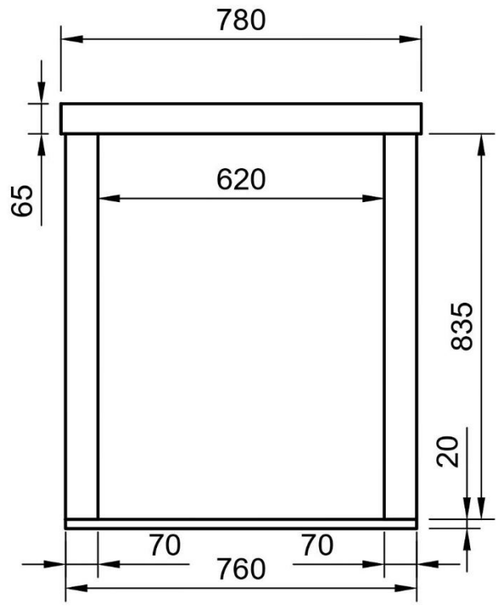
Large shelfing space to hold and store tools, materials, and other items for the user

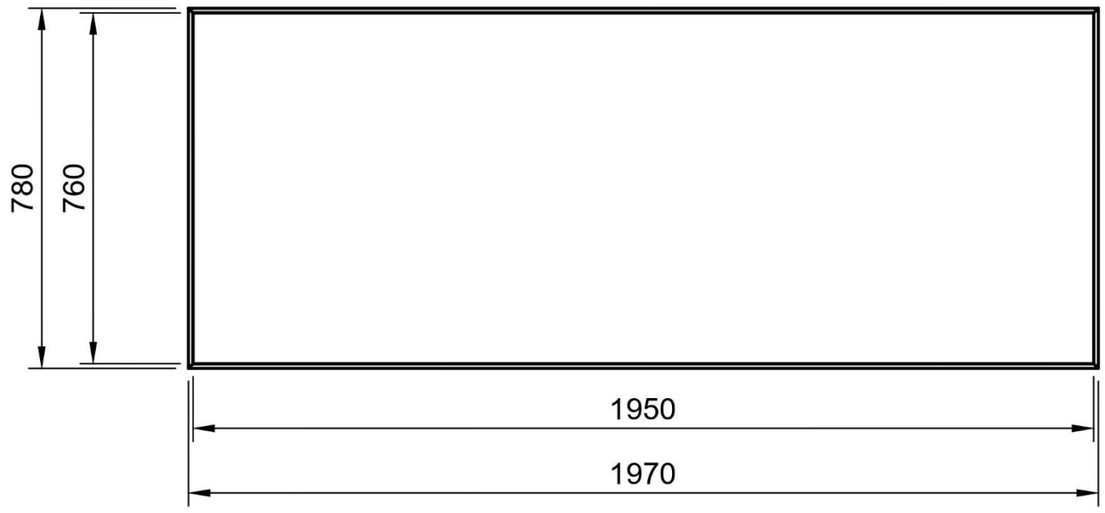
PREFERRED OPTION

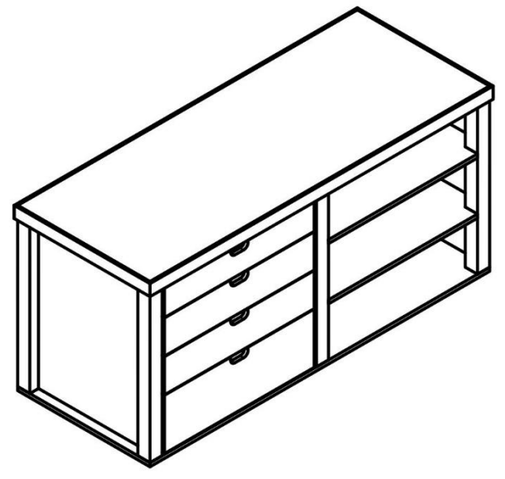
Justification:

My end-user rated design option one as the highest rated with a score of 23/25. It was an immediate decision; he liked the finishing structure and construction design with it being clean minimalistic and aesthetically pleasing look. He stated that he liked the shelfing and various sizes of drawers as they were important requitements, furthermore going on to say how important it Is that it can actually fit in the garage Though this was already thought about so all the designs fit the constraints and dimensions set. This was rated as the highest design option due to It fitting most if not all the selected criteria.









Dept.	Technical reference	Created by	Approved by
PDT	N/A	Bavreet Ubhi 18/11/2022	Rob Kayler-Thomson
		Document type: Working Drawing	Document status: Compleate
		Title: Option 1: Preferred Workbench	DWG No.: 5
			Rev.: 4 / Date of issue: 18/11/2022 / Sheet: 1/1

PRODUCTION PLANNING

Materials cutting list (costing):

part	material	length	Width	Hight	amount
MDF top	MDF	1950	760	25	1
Long top side	...	1970	10	65	2
Short top side	...	780	10	65	2
Legs	Pine	850	70	70	6
Top supports	Pine	850	620	20	2
Shelfs	Pine	760	975	20	2
Small drawer front	Pine	850	20	150	2
Medium drawer front	Pine	850	20	190	4
Large drawer front	Pine	850	20	270	4
Small drawer large piece	Pine	820	20	150	4
Small drawer small piece	Pine	330	20	150	4
Medium drawer large piece	Pine	820	20	190	8

PRODUCTION PLANNING

Medium drawer small piece	Pine	330	20	190	8
Large drawer large piece	Pine	820	20	270	4
Large drawer small piece	Pine	330	20	270	4

PRODUCTION PLANNING

Sequence of Product Steps:

Step	Process and materials	Equipment	Safety precautions	ETA time
1	Measuring and marking the wood	Measuring tape, chalk	Careful when lifting heavy pieces	1.5 hr
2	Marking out all the timber to the required length and sizes	Pencil, square, tape measure		45 min
3	Cutting 4 pieces of the timber to the size of the large bottom shelf	Mitre saw, earmuffs, glasses	Done by Mr Kt or Matt	5 min
4	Marking out the newly cut planks for dominos	Pencil, tape measure, square		45 min
5	using domino machine to carve out the holes for the dominos	domino machine, vacuum, earmuffs, glasses, clamps	secure loose clothing, check connections, clamp the planks	3 hr
6	testing and ensuring everything fit	clamp		10 min
7	gluing the 4 planks together with the dominos and securing with clamps	glue, dominos, clamps		30 min
8	sanding down both sides of the bottom shelf with an orbital sander	orbital sander, earmuffs, glasses	secure loose clothing, check connections, clamp the bottom shelf	1hr
9	cut the marked legs and store for later	Mitre saw, earmuffs, glasses	Done by Mr Kt or Matt	5 min
10	cut the marked wood to the correct length for the small shelfs	Mitre saw, earmuffs, glasses	Done by Mr Kt or Matt	5 min

PRODUCTION PLANNING

11	Marking out the newly cut planks for dominos	Pencil, tape measure, square		30 min
12	using domino machine to carve out the holes for the dominos	domino machine, vacuum, earmuffs, glasses, clamps	secure loose clothing, check connections, clamp the planks	1.5hr
13	testing and ensuring everything fit	clamp		10 min
14	glue 4 planks together with titebond and place the dominos inside the holes then securing with clamps	glue, dominos, clamps		30 min
15	sanding down both sides of the two shelves with an orbital sander	orbital sander, earmuffs, glasses	secure loose clothing, check connections, clamp the shelfs	1hr
16	trim the marked as top supports timber on the table saw to get it to the right width	table saw, earmuffs, glasses	Done by Mr Kt or Matt	15 min
17	cut the planks to the correct length	mitre saw, earmuffs, glasses	Done by Mr Kt or Matt	5 min
18	Marking out the newly cut planks for dominos to create 2 separate support pieces	Pencil, tape measure, square		30 min
19	using domino machine to carve out the holes for the dominos	domino machine, vacuum, earmuffs, glasses, clamps	secure loose clothing, check connections, clamp the planks	1.5 hr
20	testing and ensuring everything fit	clamp		5 min
21	glue 4 planks together with titebond and place the dominos inside the holes then securing with clamps	glue, dominos, clamps		30 min

PRODUCTION PLANNING

22	sanding down both sides of the two shelves with an orbital sander	orbital sander, earmuffs, glasses	secure loose clothing, check connections, clamp the shelfs	45 min
23	mark dominos for the top supports and the 4 of the legs	Pencil, tape measure, square		10 min
24	using domino machine to carve out the holes for the dominos that were just marked	domino machine, vacuum, earmuffs, glasses, clamps	secure loose clothing, check connections, clamp the planks	40min
	glue the top supports and legs together with titebond and place the dominos inside the holes then securing with clamps	glue, dominos, clamps		30 min
25	When dry sand glue and wood	orbital sander, earmuffs, glasses	secure loose clothing, check connections, clamp the shelfs	30 min
26	align the top supports+leg and regular leg pieces to the corners and centre of the large bottom shelf and mark their location	measuring tape, square, pencil		10 min
27	flip the large bottom shelf on to its side and place next to a table		get help to move as it will be heavy	2 min
28	align, glue, clamp and screw the supports+legs and regular legs into place	glue, clamp, screws, drill, drill bit (same size as screws),	secure loose clothing, check connections, clamp the legs, be aware of surroundings, electrical safety	30 mins

PRODUCTION PLANNING

29	When dry sand glue and wood	orbital sander, earmuffs, glasses	secure loose clothing, check connections, clamp the shelfs	30 min
30	align shelfs and mark their location	measuring tape, square, pencil		20 min
31	add a support piece under the marked location for the shelfs	nail gun, glue, rip cut saw	secure loose clothing, check connections, electrical safety, watch surroundings and fingers	10 min
32	drill holes into both the shelfs and the legs where they will connect	dill, drill bit	secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	5 min
33	add glue and a dowl in the holes and glue on top of the shelf support, then align and secure the shelf with a clamp	dowl, clamp, glue,		10 min
34	When dry sand glue and wood	orbital sander, earmuffs, glasses	secure loose clothing, check connections, clamp the shelfs	30 min
35	mark up the MDF top to size	measuring tape, square, pencil		10 min
36	setup track saw and cut along the marks	track saw, vacuum, rails, and clamps	clear debris, secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	15 min

PRODUCTION PLANNING

37	trim the remaining pieces of MDF to be able to go underneath to further support weight	table saw, earmuffs, glasses	Done by Mr Kt or Matt	15 min
38	glue the strips into place and use nail gun to secure	glue, nail gun, earmuffs, glasses	secure loose clothing, check connections, electrical safety, watch surroundings and fingers	20 min
39	flip over so flat tabletop is on the top and test fit on the bench frame			2 min
40	cut the hardwood to length both short side and long side of the table and add a 45-degree mitre of both edges of each piece	mitre saw, earmuffs, glasses	Done by Mr Kt or Matt	10 min
41	screw the outside pieces onto the edge of the tabletop	screws, drill, countersink drill bit	secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	45 mins
42	measure and mark out the sizes of the 8 drawers	measuring tape, square, pencil		30 min
43	get the planks cut	mitre saw, earmuffs, glasses	Done by Mr Kt or Matt	20 min
44	glue and counter sink screws in to ensure a sturdy joint	glue, countersink drill bit, drill, clamps, screws	secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	1.5 hr

PRODUCTION PLANNING

45	glue and nail MDF bottom to the drawers	glue, nails, hammer	mind hand and fingers	1 hr
46	rout around edges to remove excess material	router,	secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	20 min
47	mark centre of each side piece on the drawers	measuring tape, square, pencil		30 min
48	line up the drawer runner's drawer member with the centre line and drill holes at the holes on the drawer runners	drill, drawer runners	secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	40 min
49	screw the drawer runners into place making sure they flush with the face	impact driver	secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	30 min
50	remove the cabinet member and attach it mark out holes for drilling where it will be attached to on the inside of the workbench	measuring tape, square, pencil		30 min

PRODUCTION PLANNING

51	drill holes where there are marks and screw in the cabinet runner	drill, drill bit, screws	secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	1 hr
52	slot in the drawers back into the cabinet runners			10 min
53	cut out the drawer fronts	mitre saw, earmuffs, glasses	Done by Mr Kt or Matt	10 min
54	rout out a slot to open and close the drawers on each drawer front	router,	secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	20 min
55	add the drawer fronts to the drawers' using screws and glue	drill, drill bit, screws, clamp, glue,	secure loose clothing, check connections, electrical safety, watch surroundings and fingers and clothing	30 min

Risk Assessment

Impact

	Negligible	minor	moderate	significant	severe
Very likely	Low medium	Medium	Medium high	High	High
likely	Low	Low medium	Medium	Medium high	High
possible	Low	Low medium	Medium	Medium high	Medium high
unlikely	Low	Low medium	Low medium	Medium	Medium high
Very unlikely	Low	Low	Low medium	Medium	Medium

Likelihood

PRODUCTION PLANNING

Risk assessment:

process or activity	Hazard	Possible harm	Likelihood/ seriousness	Risk controls
Using the router	Cord across walkway	Injury from being tripped	Medium/ low	Tap cord or run above workbench
	Blade cutting through cable	Electrocution	Low/ high	
	Sharp spinning bit	Dust and splinters hitting face or eyes	low/ medium	Ware eyeglasses and ware appropriate clothing
Using the drill	spinning/moving parts	Hair/ clothes being pulled in	Medium/ high	Tie back hair and don't ware loose clothing
	Burns from hot drill bits	Burns on hands and fingers	Medium/ medium	Wait for the bit to cool before grabbing
	Vibration	Carpal Tunnel Syndrome	Medium/ medium	Select power tools with lowest vibration levels.
		Hand/Arm Vibration Syndrome (HAVS)		Minimise the time individuals use the equipment
Impact driver	Noise	Hearing damage	Medium/ medium	Wear hearing protection if above 80dB or if uncomfortably loud
				Advise nearby persons of hazard.
	Electricity	Electric shock	Low/high	Check condition of lead and plug before use.
				Do not work where water is present
Table saw	Tool jamming or binding	Wrist	Low medium	Check tool is appropriate for the job and used in accordance with manufacturer's instructions.
		hand injury	Low/ medium	Trained operators only (or under strict supervision
Mitre saw	Moving parts	Entanglement	Medium/high	Loose clothing, jewellery, and long hair to be kept clear of moving parts.

PRODUCTION PLANNING

	Electricity	Electric shock	Low/ high	Do not work where water is present without specialist advice
	Flying debris, swarf etc.	Eye, hand, or facial injury	Medium/ high	Use protective eyewear or face shield. Use guards where appropriate
Orbital sander	Vibration	Carpal Tunnel Syndrome	Medium/ medium	Ensure tools are properly stored, maintained, and used according to manufacturer's instructions.
	Dust	Skin irritation	Medium/ low	Wear suitable protective clothing (especially gloves).
		Respiratory illness	Medium/ high	Use a dust mask (check for fit).
Belt sander	Ergonomic	Musculo-skeletal injury	Low/ medium	Ensure there is adequate room to do the job
	Vibration	Hand/Arm Vibration Syndrome (HAVS)	Medium/ medium	Restrict use of vibration inducing tools to recommended times
	Noise	Hearing damage	Medium/ medium	Wear hearing protection if above 80dB
Domino machine	Vibration	Hand/Arm Vibration Syndrome (HAVS)	Medium/ medium	Select power tools with lowest vibration levels.
	Moving parts	Entanglement	Medium/ High	Loose clothing, jewellery, and long hair to be kept clear of moving parts.
	Tool jamming or binding	Wrist/hand injury	Low/ High	Check tool is appropriate for the job
Track saw	Ergonomic	Musculo-skeletal injury	Low/ Medium	Ensure there is adequate room to do the job.
	Moving parts	Entanglement	Medium/ High	Use guards where appropriate.
		Hair/clothes being caught		Loose clothing, jewellery, and long hair to be kept clear of moving parts.

PRODUCTION PLANNING

Quality Management:

When selecting Look for flaws:	tiny holes that might affect strength or appearance, variations in colour or even thickness, or skewed weave (fabric). material Look for warping, check that the grain suits your construction, check for knots where strength may be required (wood).
Before laying out pattern pieces or templates	Check that the amount of material is sufficient. Check that the material is clean. Wash material to pre-shrink if necessary (fabric).
When laying out pattern pieces or templates	Check that pieces are laid out accurately, along or with the grain as required for the material. Lay pieces as close together as possible to minimise waste (all materials) but include room for saw cuts when marking out (wood, metal, and plastics). Before marking Double-check all measurements and re-measure if necessary. Check for squareness on face and edge (wood). material
When marking material	Make sure angles are accurate, especially any right angles, by using a set square (wood). Mark lightly or use an instrument for marking that will not show up on final product (or can be easily removed)
When cutting pieces	Concentrate and cut as accurately as possible using conventional guiding methods. Label pieces with removable marker or chalk to avoid mix-ups.
Before joining pieces	Label pieces with removable marker or chalk to avoid mix-ups.

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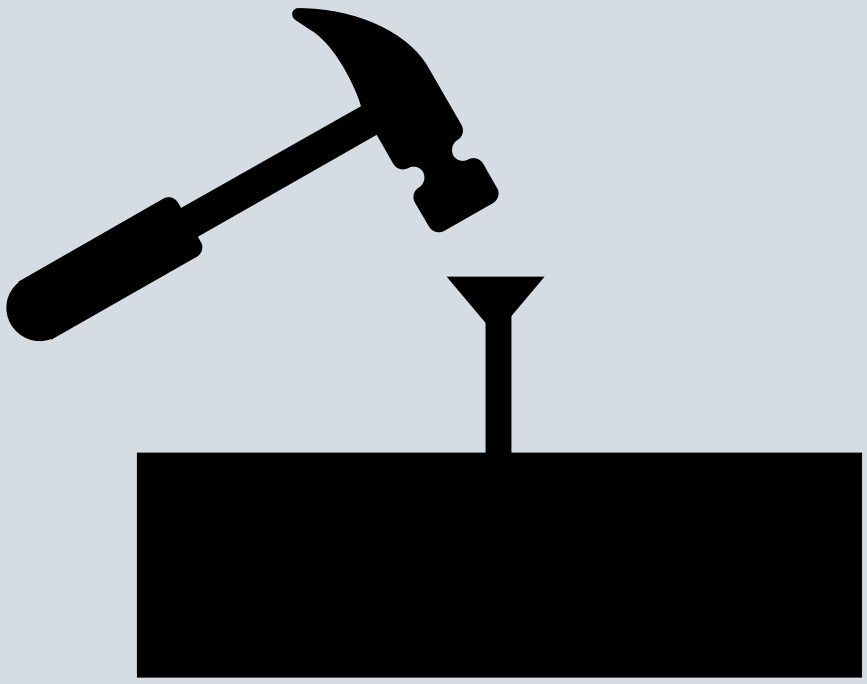
PRODUCTION

Use of Materials:

Material name	Image	Description of use
Pine		Pine planks are the main material used to construct the workbench, they are used to make a strong structure and clean aesthetic.
cherry		The workbenches tabletop has an outer perimeter made of cherry as it is a hard wood which will allow for extensive use before having to be replaced by the user
MDF		The tabletop is made out of a slab of MDF as it is relatively cheap and easy to replaced when it has extensive ware and tear
Nails		Nails were used to join pieces of wood together, when paired with glue it forms an extremely strong bond

PRODUCTION

Screws		Similar to the nail's screws were used to form a even stronger bond between the pieces
Glue		Glue was user to secure the pieces of wood together, sometimes used to assist the bonding of nails and screws. It was also used alongside dominos to create a large flat sheet
Dominos		Dominos were placed inside holes with on the sides being joint together, glue would be poured into the gap to form a strong bond



PRODUCTION

Use of Equipment:

Name of tool:	Image:	Description of use:
Mitre Saws		To cut the planks to scale and add angles mitres
Table saw		To thin the planks width
Domino machine		Create holes to insert the dominos
Drill + drill bit		Drilling holes for screws and dowls
Impact driver + Philips attachment		Screw in the screws
Belt sander		Heavy duty sanding and removing large bumps
Orbital sander		To sand and finalise the finish on the surfaces
Vacuum		Sucking up all dust/ sawdust/ sanding from workspace
Chisels + Sandpaper		Used to clean up and finalise the product and remove glue

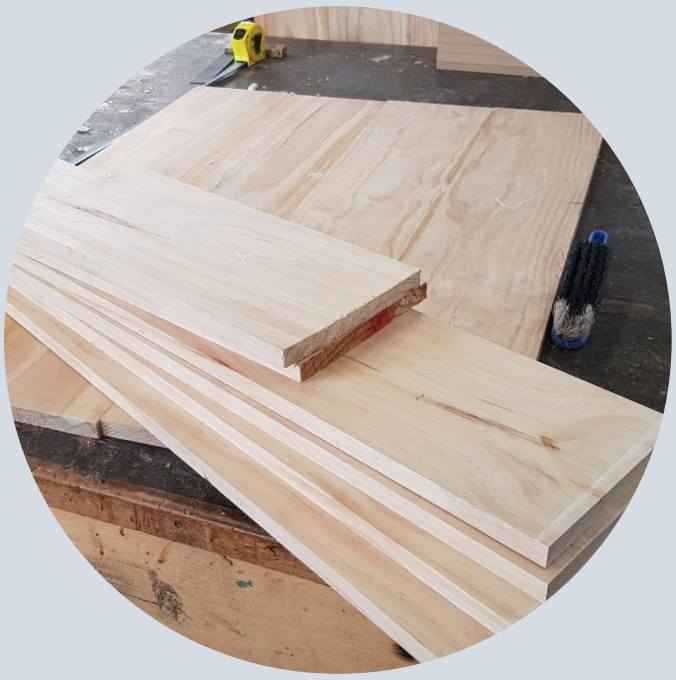
PRODUCTION

Modifications:

Modification	Reason	Image
Decrease in width	The overall width of the work bench and tabletop was decreased by 40mm as it wouldn't require any cutting to create and be more usable as the end user can easily reach over the table without needing to bend over	
shelf rearrangement	The selves were rearranged to all be equal sizes as they already are large enough as is and have more then enough space to holster tools and materials	
Alteration of Drawers	Like the shelfs the drawers were altered to be suited better, instead of 3 drawers on either side there is now 4 which allows for more storage and easier organisation	
Addition of hardwood brim around the MDF top	The new hardwood brim protects the MDF from getting damaged as well as providing contrast with the light pine	
Removal of side table	As the progression of the table was quite slow in the beginning the end user decided to remove the side table so it would be completed in time	

PRODUCTION

Production Journal:



3/08/2022

Production began as materials were marked and prepared. Materials and tools used include the pine planks, chalk, and a tape measure.

5/08/2022

After marking the domino machine was user to prepare the planks to be joined to make shelfs. After making the notches glue was applied and the dominos inserted then the whole setup was clamped together Materials and tools used include the pine planks, pencil, tape measure, square, domino machine, glue and PPE.

PRODUCTION

Production Journal:

8/08/2022

This day was full of removing clamps from the shelfs and sanding them down their to near final quality. Materials and tools used include the orbital sander, chisels, plane and PPE

10/08/2022

The day was put towards the construction o the bottom of the work bench, using the same materials and tools as used when creating the shelfs: pine planks, pencil, tape measure, square, domino machine and PPE.

12/08/2022

Continuing over the previous day, I continued preparing the bottom for joining using the same materials and tools: pine planks, pencil, tape measure, square, domino machine and PPE.

PRODUCTION

Production Journal:

15/08/2022

Continuing on what I completed the last day, I continued joint the planks to form a large piece. Using the same materials and tools: pine planks, pencil, tape measure, square, domino machine, glue and PPE

17-22/08/2022

I began sanding the large bottom to get a quality finish using the orbital sander, chisels, plane and PPE

24-26/08/2022

These days were spent cutting the edges of the newly constructed shelfs and bottom using a track saw and shop vac and with appropriate PPE.

PRODUCTION

Production Journal:

29/08/2022

This day was spent marking up the two vertical supports for the top, items used were pine planks, pencil, tape measure and a square

30/08/2022

This day followed on from the last, I got the wood cut using a table saw reducing the width and length, Materials and tools used include the table saw and PPE

31/08/2022

The planks had the dominos slots cut and got glued and dominoed together, both supports were clamped and stored for later

2/09/2022

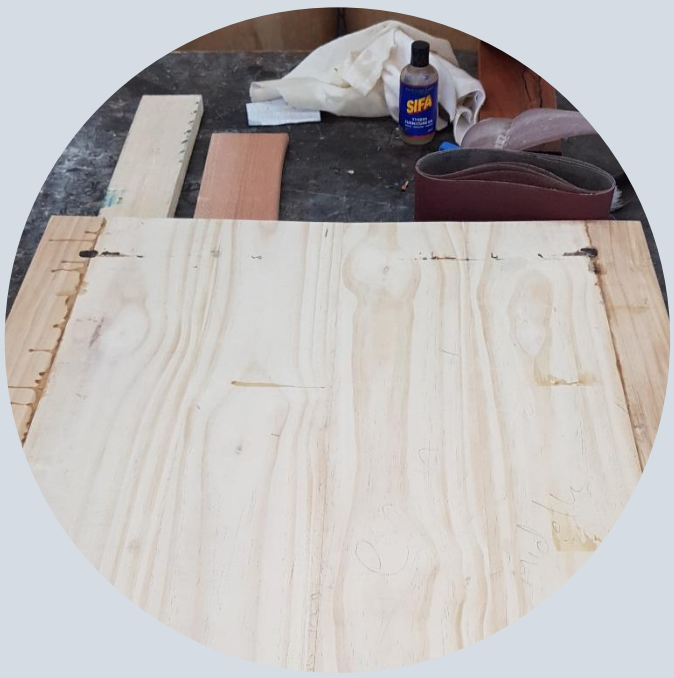
I cut got the legs cut to size and stored them for later, using a pencil, tape measure a miter saw

PRODUCTION

Production Journal:

7/09/2022

2 legs were attached to the thin support as it would give more strength, it was joined using dominos and glue which and being clamped together, this was completed using the domino machine, glue, and clamps



9 - 12/09/2022

September 9 and 12 were spent trying to flatten the arc in the wood using the belt sander, tools used on these days were the belt sander, glasses, earmuffs and the shop vac

14 - 16/09/2022

Test fitting and final sanding of the parts began, using sandpaper, the orbital sanders with high grit paper and chisels

PRODUCTION

Production Journal:

5/10/2022

I encountered a large issue with both sides of the large support having a 2mm overhang. To resolve this the faces were trimmed of using the miter saw

7/10/2022

Real progress began as I screwed the legs and supports into the bottom of the table

10-14/10/2022

The shelfs were molded and cut to fit inside the legs and supports, having their edges dominoed into the legs and a piece of timber on the other side for added stability and strength, tools used include a drill, orbital sander, dowels, glue and a nail gun

PRODUCTION

Production Journal:

12/10/2022

The piece of MDF that will form the tabletop was test fitted and marked up for cutting using the track saw with a simple pencil, ruler and square

17-19/10/2022

The marked MDF was shifted and had the track saw attached and clamped, it was used to cut off the access material. After cutting it was placed back on the table for a second test fit where the workbench started to take shape

PRODUCTION

Production Journal:

24/10/2022

The spare MDF was used to add strength and structure to the single piece, this was done by using a nail gun clamps and glue

26-28/10/2022

The 26th of November was spent making a miter block to cut the 45-degree angles for the hardwood.

28th of November the miter block was used, and the angles were cut, then the long brim was attached using screws. Items used between theses days include a rip cut saw, square, pencil, nails, glue a hammer, drill, impact driver and clamps

PRODUCTION

Production Journal:

2-4/11/2022

The day was spent fixing the rocking off the tabletop due to the middle being slightly to high, it was fixed by using a belt sander to remove the highs and putty to fill the gaps.

7-11/11/2022

7th and 11th were used to make the drawers that would fit into the workbench, they were made using clamps glue and screws, with the use of a drill and impact driver

PRODUCTION

Production Journal:

14-16/11/2022

After completion of all of the frames of drawers MDF bottoms were attached and nailed and the edges were routed for a flush finish, tools used include the router and hammer

16-18/11/2022

18th November was spent adding the drawer runner onto the drawer edges by screwing them on, this was done by using a drill, impact driver, pencil, ruler and square

PRODUCTION

Production Journal:

23/11/2022

The finished drawers had their cabinet runners installed and the drawers were put into place. In the following days the castors will be added for portability, the electricity extension will be installed, and the drawers will have their drawer faces installed

Evaluation

Evaluation criteria 1: will the workbench be sturdy enough to handle damage and not get damaged?	
Checking method	To check this, I went through and tested if the table was sturdy and able to take a beating by using multiple tools and even building parts of the workbench on itself.
End-user comment	The end-user is more then happy with the result seeing a capable and sturdy table when tested he said “this is perfect”.
My response	As my first time building a workbench I’m proud of how sturdy it has turned out being able to take a beating without any damage.
Improvements	It would have been nice to be make it even more durable and reduce a slight creaking sound.
Evaluation criteria 2: Is the workbench portable?	
Checking method	This was checked by moving the workbench around and seeing how it felt to move.
End-user comment	The end user commented that the table was quite heavy and difficult to move but this is because of it not having the castors installed.
My response	The table was hefty without the castors but when installed it’ll move like a breeze.
Improvements	I believe it would help if I had finished the project on time so the end user would have been able to add the castors to make it easy to move.

Evaluation

Evaluation criteria 3: Is the tabletop going to be interchangeable?	
Checking method	This was simply done by lifting the tabletop and adding other level things to confirm flatness and taking the table top off a few times and make sure it works correctly.
End-user comment	The end user commented that he was happy how the tabletop turned out, even though it is a bit heavy its not too bad to replace.
My response	Similar to the end user I was happy how the tabletop turned out as it is very strong, but this makes it quite heavy and hard to lift alone
Improvements	Trying to add an internal aluminium frame too keep the strength but drastically reduce weight
Evaluation criteria 4: Will the workbench be sustainable?	
Checking method	To check this, I went through and checked how much was wasted and what happened to the offcuts.
End-user comment	The end user was quite impressed that there wasn't much waste.
My response	To keep the waste low I made sure to use as much off the offcuts as possible, so I used them to create jigs.
Improvements	I should further check on how and ware the timber was grown and if it is a sustainable source.

Evaluation

Evaluation criteria 5: Does the workbench fit in the garage	
Checking method	This was simply checked by measuring the final dimensions of the table and comparing them to the space available in the garage.
End-user comment	The end user was impressed how well it fits and said “he didn’t expect it to fit so sound”
My response	I to was surprised how well it fit in the garage without blocking up space
Improvements	It would have been nice to improve the visual look a bit more and possibly has some colour or varnish to further protect the timber

Evaluation of the Production Timeline:

The product timeline was mostly followed but due to a couple of issues along the way the work got pushed back resulting in a delayed completion, the end user is completely fine with this and prefers quality over speed. He wished to have it in by the 6th December as he wont be here to collect it after. The project mostly was able to stick to the schedule primary hindrances were the mistakes which needed to be fixed

Client Feedback:

The client was more then delighted in the final product and says its perfect for the jobs he will use it for, it follows the criteria and constraints he had set matches what he had envisioned for his dream workbench. He says that he already has uses in mind.

Evaluation

Care label:

Care for heavy duty workbench

Pine is known for warping when over exposed to water, make sure to keep the workbench in a dry environment and if it gets wet wipe the water with a dry rag

Periodically measure to make sure there isn’t water damage to the top

The MDF tabletop might start to disintegrate when there is too much moisture, keep I relatively dry and wipe of any water

Product Features:

The product has come with a variety of features like asked for by the end user, this includes the drawers with ranging heights to allow for each one to be dedicated to a specific set of items, the workbench comes with a heavy duty 50mm thick MDF top meaning there’s no chance of it getting damaged by any basic tool. It comes with a outer brim which is made of a hard wood that’s screwed in, this results in it being replaceable and interchangeable when it gets damaged similar to the MDF top. The shelfs now have a symmetrical design for improved aesthetics as they already provide ample space for tools and items. The legs have had a 30mm size reduction to increase the amount of space.