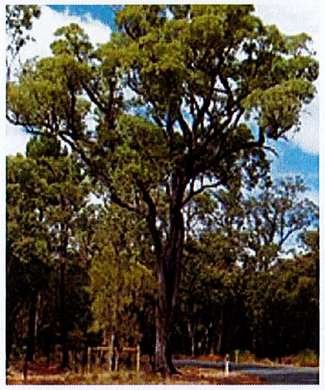
CRITERIA 5

17154677A

Materials Research

MATERIAL	MATERIAL ORIGIN	ADVANTAGES AND DISADVANTAGES	SUMMARY
		**TASMANIAN OAK** Advantages • Durable • Easy to work with. • Straight wood grains Disadvantages • Light colour	Tasmanian Oak is an Australian Hard Wood. It is Grown in the mountain ranges of Tasmania. It has is very light in colour. It would be good for my project because it has properties of durability. Prices can range from $5850-8900 per cubic metre. The timber is easily accessible for the region being located in multiple stores in the area. It wouldn't be good for my project because it is too light in colour and my user requested a darker colour material. I would also have to stain the timber if I was to consider it as a potential material.
		**JARRAH** Advantages • Durable • Dark in colour • Tough • Resistance to rotting. Disadvantages • The timber is very expensive. • Can be filled with knots.	Jarrah is an Australian hardwood renowned for its versatility, durability and strength. It is typically used in furniture making and musical instruments. It would be a good material to use as it is a hard wood so it is tough and durable. Jarrah is grown in Western Australia. Here it is sustainably produced, even though it has a very slow growth rate at less than 1m per year. Being domestically grown it isn't too difficult to source. The timber has a strong resistance to rotting. This would mean the table would last for a long period of time. Jarrah is however, expensive and I may go over my users budget. It can also be prone to having knots so I may have difficult in sanding the table which may add to my total production time.
		**MERBAU** advantages • Durable • Dark in colour • Tough Disadvantages • Typically changes colour as it ages. • Relatively easy to bend and turn. • The timber can bleed when it is cut.	Merbau is a popular hardwood from South East Asia and northern Queensland it's used in a wide range of applications, from construction to indoor and outdoor furniture. It would be suitable for my product as it is dark in colour. It is also a very durable timber being used often for decking and outdoor furniture. Merbau is so tough that it is rather termite resistant. The timber has excellent strength characteristics which make it less prone to warping. Merbau can cost up to $280 to $320 per square meter, meaning it will be well inside my budget range. However, being so tough the timber may be very difficult to work with. This may blunt tools very quickly and slow down my production time if I am struggling to cut and drill the timber

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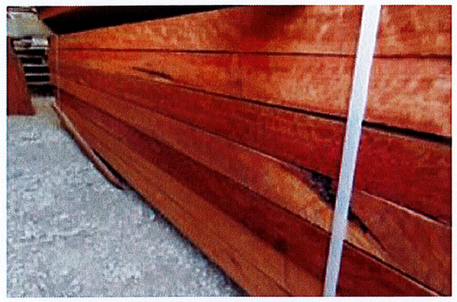
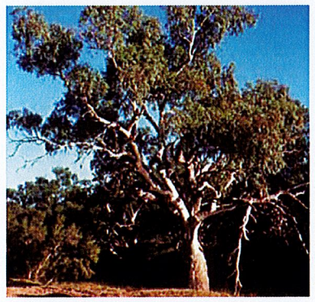
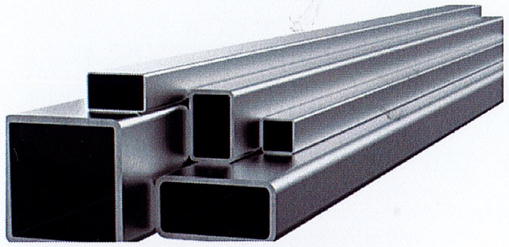
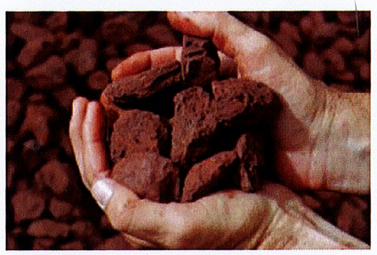
		**RED GUM** Advantages • Durable • Dark in colour • Tough Disadvantages • Very heavy • Prone to knots	Redgum is a versatile, dense and durable hardwood, with a light to dark red colour. It is perfect for flooring, decking, construction and furniture making. It is very red in colour and may be difficult to match with the recycled table top. Redgum is a suitable product for me as it is very durable and dark in colour which has been requested by my end user. However, Red gum has a very curved grain. This can make sanding very difficult, which may add to production time.
		**GALVANISED STEEL** Advantages • Durable • Tough • strong • Stain resistant Disadvantages • Need advanced skills to work with it. • Will rust if left untreated.	Galvanised Steel is very strong and durable. It has many options for different types of finishes. It would be a suitable option to help build a strong table and durable table because of the material properties. It has a large variety of options for a finish. It could be painted any colour of my choice which could match the recycled timber surface. The galvanised Steel is sustainable in a way that it can be recycled very easily. It usually costs around $15 per metre, so enough for my table would mean I would be under budget. However, It may be very heavy for my end user trying to move the table around and the aesthetics of the product are not great.
		**EASTERN MAHOGANY** Advantages • Durable • Dark in colour • Tough Disadvantages • Expensive	Eastern mahogany is a very strong and durable timber. It is dark in colour and available in Australia. The timbers durability would be great for my table as the table being durable was requested by my end user. The timber also has a very natural appearance of being darker in colour with a lot of strong grains that are present. This can add a very large visual appeal for the tables frame. The timber is suitable to me as it is a hardwood so it is tough and durable. The timber is also very accessible as it is located in many local stores. However, the downside is that it can be expensive, but it can still lie within my budget for the table. Eastern mahogany usually costs around $80 per sq/m.

Bibliography:

https://www.woodsolutions.com.au/wood-species/jarrah https://www.woodsolutions.com.au/wood-species/redgum

http://mahoganykeishina.blogspot.com/2017/06/eastern-mahogany.html https://www.australianmining.com.au/news/global-iron-ore-production-expected-to-plummet/

https://www.woodsolutions.com.au/wood-species/merbau https://www.metalsupermarkets.com/the-differences-between-304-and-316-stainless-steel/

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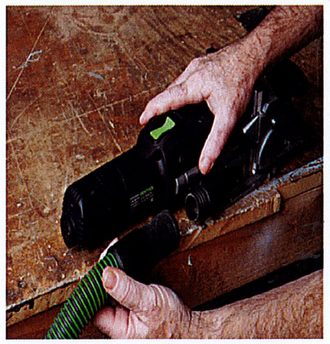
Domino Joining

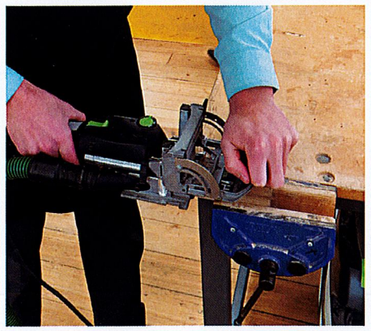
Overview

The tables lower frame needs a precise and durable joint to hold it together. There is many joins to be made at the bottom so a domino joint is my selection as it fits the criteria and can be quickly performed using the domino router cutter. The cutter is precises so the domino will fit accurately in the cut slot.

The Domino router was set up to route the centre of a test piece of Pine. From the test piece we can test the strength of the join and the practicality.

The router was set up with dust extraction to ensure appropriate safety measures where taken.





Two identical pieces of pine where cut to use as a test for the Domino joint. The two pieces where marked in the middle ensuring that both pieces where identical.

The domino was then cut out by the router to the required depth and the router then plunged into the pine.

The Domino was then gently sanded to allow easy grip between the glue and the pine. Then the domino was inserted into the slot. Then with a cloth any excess glue which may have come out of the slot was wiped away.

One the surface was glued the two pieces where clamped together and left for 24h to dry.

Why use a domino joint over a biscuit.

Domino joints are great for alignment and can be accurately set. Whereas a biscuit joint has the potential to move and slide within the grove decreasing its accuracy.

Overall result

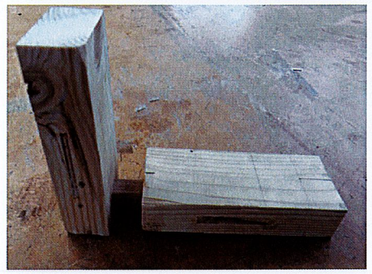
The Domino joined with pine was tested for its strength and durability. Three tests were conducted on the join.

Hammer test: Impact test

Weighted test : down force on the join

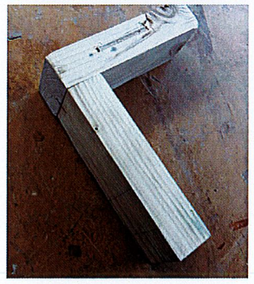
Push and pull test: Sideways force on the join.

In Summary the Domino joint was very durable throughout the testing. The Joins would be able to withstand any significant impacts or strength strain on the frame. The only time it buckled was when it was significantly hit with a hammer at full force.



The Pine joined with a domino was wacked with a rubber mallet. At medium pressure the timber did not move. With high force the join snapped.

The Joint showed no effect when tested for weight. This testing is similar to extreme weight being placed on top on the table frame. This is important for when the tables frame has to hold the base.



The was minor flex in the join when pressure was applied. The join remained very strong during the whole process.

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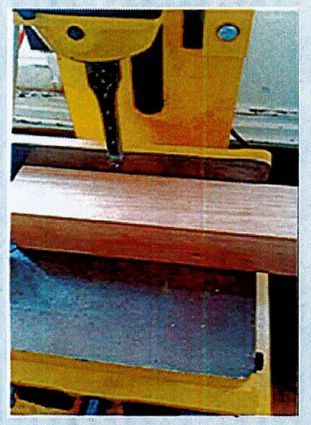
Material processes: Mortice and Tennon

Overview Mortice and Tennon:

The upper part of the frame needs a stable strong and durable support so that the table top can sit inside the panelling and on top of the frame.

Process: Morticing

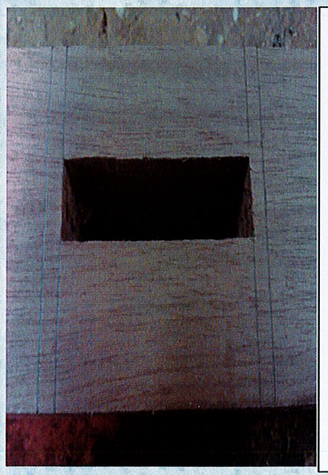


A test piece of wood was clamped into the Mortice. The wood was in line and placed accurately of where I needed a mortice cut.

The depth of the cut can be altered on the machine by turning the screw on the side of the machine. For my test piece I set the mortice to a depth of 20mm.

The Hole was then cut into the test piece of wood. You have to operate with caution to be accurate when using the mortice.

One the Mortice is cut the edges can be cleaned up with a sharp chisel to minimise any rough edges or rounded corners.

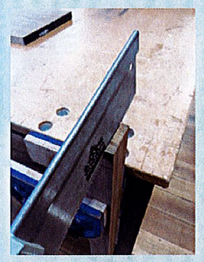


Overall result:

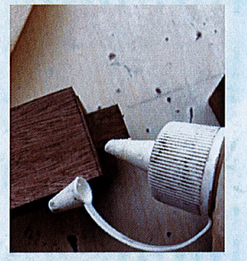
The hole was precisely made by using the morticer. This was done by using the stability of the bed and being able to move the bed side to side and perform accurate cuts. Care must be taken when making the mortice because you must create a tight fit for the Tennon.

Where will it be used?

The Mortise and tenon joint will be used in the lower half of the tables frame. It is ideal as the join has incredible strength and durability. The join also has a fantastic visual appeal which is desired for maintaining the tables quality appearance.

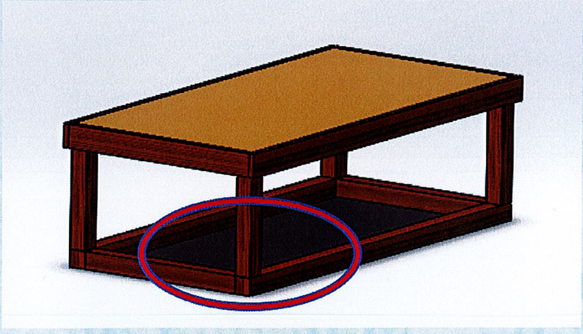


Cutting the tenon and then assembling the Mortice and tenon ready for Testing



After a flex test was conducted on the join the join with stood any force I could make. This is what makes it appropriate for the base of the frame when the table is moved.

Further pressure and strain was required to break the join.



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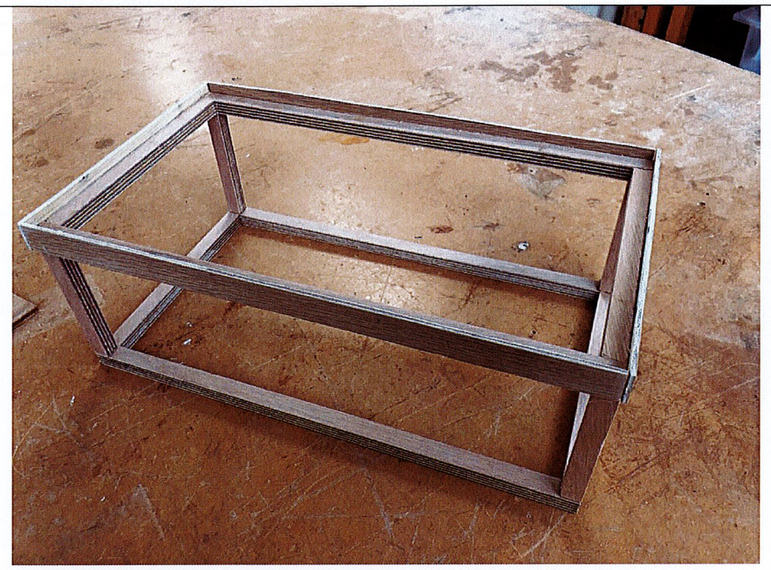
Coffee Table Model

A model has been created in 1/4 scale to test the function of the coffee table. The Design has been kept in the same shape as the chosen design however only butt joins where made to be time effective.



¼ Scale model with safety glasses as a size reference.

User Feedback:

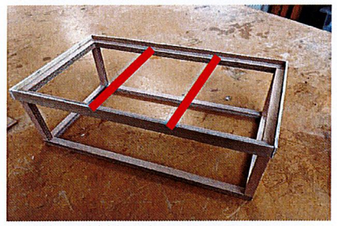
I like the model you have made. It looks exactly how I imagined. However. The removable lid is sitting too low into the frame and I would like the table top and the side rails to be flush with one another so items such as books and coffee cups can easily slide of the edge.

The centre of the table is very flexy maybe some support beams can be added to the design top give it strength in the centre of the table.

Model without the table frame showing how the table top can be removed and interchanged in the design.

Changes to design:

Two supporting beams have been added to the upper frame. This is because the table was flexing in the middle when weight was added to the centre of the table top. The makes the table more durable when it is being used.



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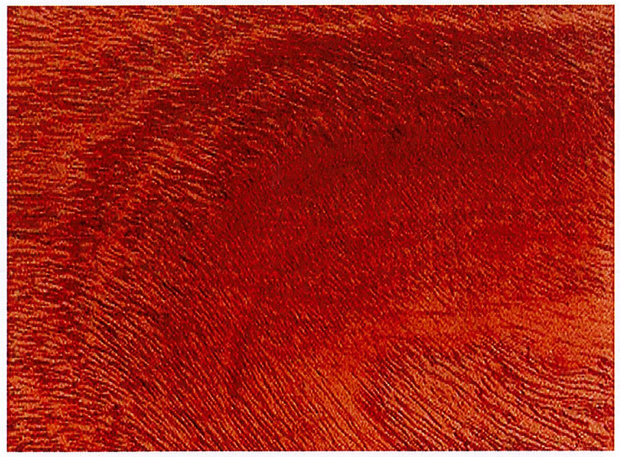
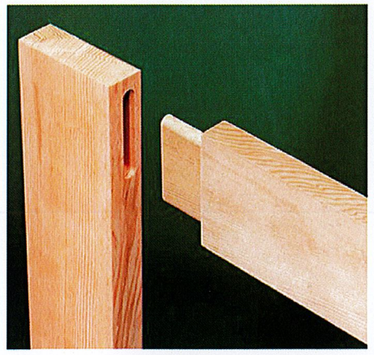
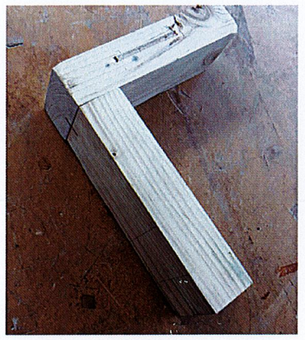
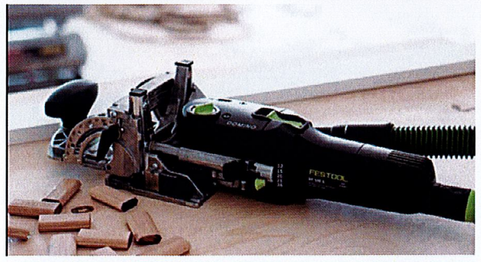
Materials Summary

Overall Timber Choice:	Joining method Choice:	Finish Method Choice:
The overall timber choice was made , Eastern Mahogany. I have chosen this material because it is tough and durable. This is important because when Jamima moves homes the table will need to be able to withstand and impact. Furthermore the timber is impact resistant materials. It also has a dark appearance which was a desired feature by my user. 	Domino routing and a mortise and Tennon joint have been chosen for my design. Domino joining was chosen as it is a simple process which is easy to perform to give a strong and durable join. It is a fast method and is also very accurate which will shorten the production time of my Coffee table so it can be produced by the deadline. Mortice and Tennon joins are a very traditional table join which is great for strength and appearance is may take more time but the quality is worth it which is what is requested in a product by my user.   	The finish that was chosen was a Wipe on Poly. This was chosen as it enhances to finish of the wood and acts as a protective layer against heat, scratches and stains. This is important as if coffee is spilt from the cup the table needs to be protected so it can be continued to be used into the future. And still remain a high quality, durable product. 

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Finish Testing

The timber was sanded down to a 400grit finish. This is a replication of how I would like the final products surface to be like as it is handed over to my user.

Then I applied four different finishes:

Wax Finish, Varnish, wipe on poly and No Finish.

Then Finishes where graded on there appearance protection against stain, heat and scratches.

Wax Finish

Varnish Finish

No Finish

Wipe on poly

Type of Finish	Protection of stains	Protection from heat	Protection from Scratches	Score
Wax	4/5	4/5	1/5	9/15
Varnish	3/5	4/5	1/5	8/15
Wipe on poly	4/5	4/5	2/5	10/15
No Finish	2/5	3/5	1/5	6/15

In Summary, the Wipe on Poly was the best scoring 10/15. This makes it the most suitable to suit the purpose of protecting my coffee table from likely damages that could occur.

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Industrial manufacturing

If my product was to be replicated on a mass scale a few adaption would have to be made to the design.

This would include creating joins that fit into place so the product could be assembled from home as a flat pack. This would involve removing domino joins and creating Screws and Cam lock nuts. This would mean the table whole table could be assembled by anyone with a screw driver.

Each piece of the table would be cut using an automated radial arm saw. This would allow a lot of pieces to be perfectly cut out, on a mass scale.

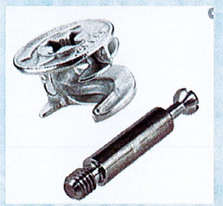
I would implement an automated production line so multiple pieces of the table could be worked on at the same time. The benefits of this is that my machines could work 24/7 and it would reduce the amount of human labour required to build the table, increasing the total productivity of my production.

The material would be cut by a CNC saw to make it standard across all pieces of material. The benefits of using CNC is that it is accurate and won't make mistakes if operated correctly.

I would adapt my design so that the top side rails and the panelling is all one piece of timber to reduce the amount of pieces involved in constructing the table. This would make the production. Of the table faster.

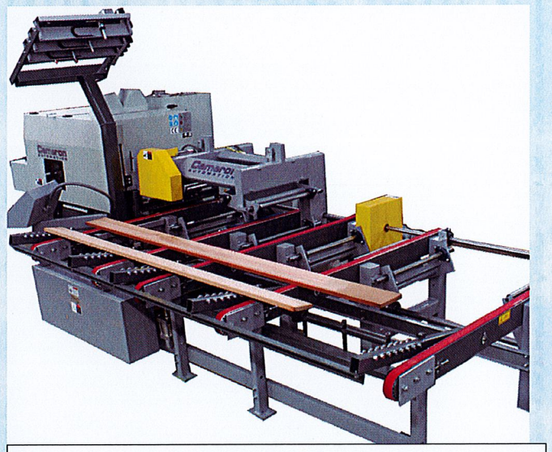
The timber can be changed from eastern mahogany to plywood.

This decision has been made as plywood would reduce the costs of the table and is a more suitable material to operate with the CNC saw and automated blades.

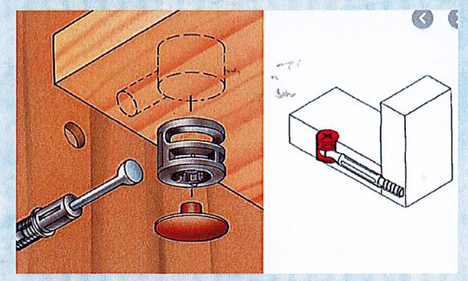


Cam lock nut and Screw

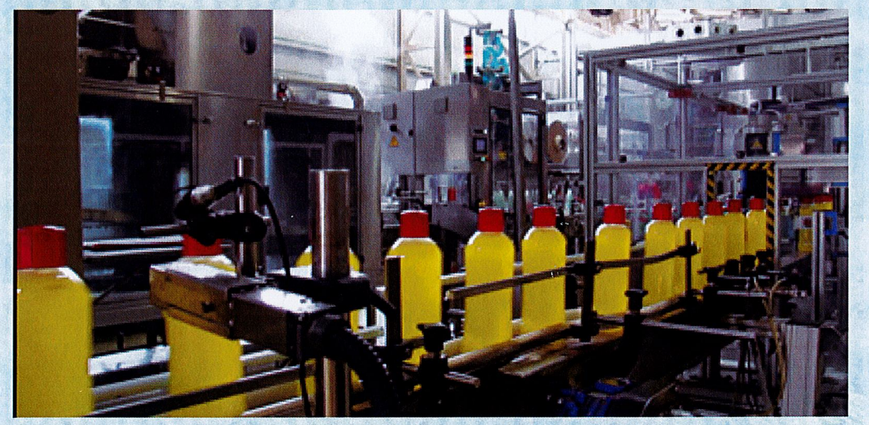
Final product in Flat pack form



Automated Saw



Operation of Cam lock nut and screw.



Automated production line

Production process

1. Cut Ply wood with automated saw.
2. Insert holes for cam lock nuts with CNC router on a production line.
3. Paint Material
4. Assemble into packaging
5. Place required cam lock nuts into packing
6. Distribute to users.
7. Assembly by user, with guidance by instructions.

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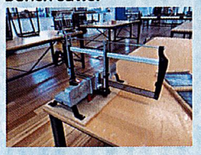
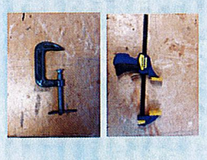
Risk Management

Picture of Equipment	Stage of Production	Possible Hazard	Possible injuries	Risk Control	PPE
Domino  cutter	Assembling my table frame.	-Moving router. -Dust. -Noise. -Flying debris.	Elastration's. Dust inhalation. slipping on floor. Tinnitus. Cuts and scratches from flying debris. Dust debris in eyes.	Extraction unit and safety mask. Safety glasses. Clamps quick grips, vices, jigs, Take time and don't rush.	
Mortise and tenon 	Assembling my table frame.	-Dust. -Noise. -Flying debris.	Elastration's. Dust inhalation. Slipping on floor. Cuts and scratches from flying debris Dust debris in eyes. .	Extraction unit and safety mask. Safety glasses. Clamps quick grips, vices, jigs, Take time and don't rush.	
Bench saws. 	Cutting the table mitre joints in the table.	-Dust. -Moving blade.	Elastration's. Dust inhalation. Slipping on floor. Dust debris in eyes.	Safety glasses and clamps, quick grips. Take time and don't rush.	
Bench clamps. 	Holding the frame together while gluing.	-Clamping mechanism	Crushing fingers.	Ensure that the clamps are fixed to the wood and keep feet clear of the potential drop zone.	
Tape measure 	Measuring and marking materials	-Cutting	Cuts to hands	Ensure that the tape measure isn't retracting uncontrollably.	

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