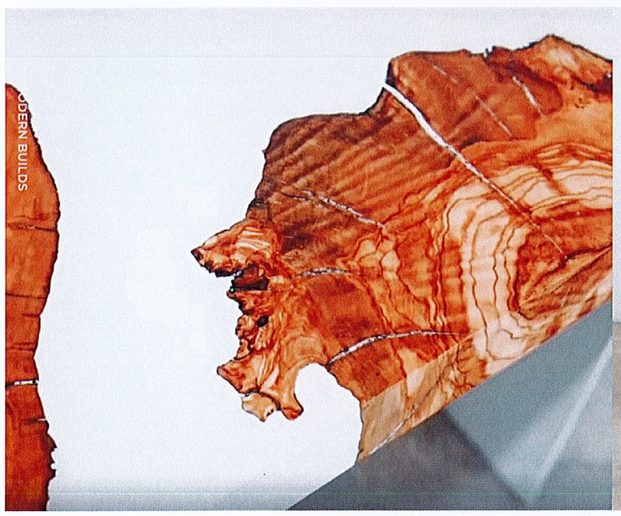
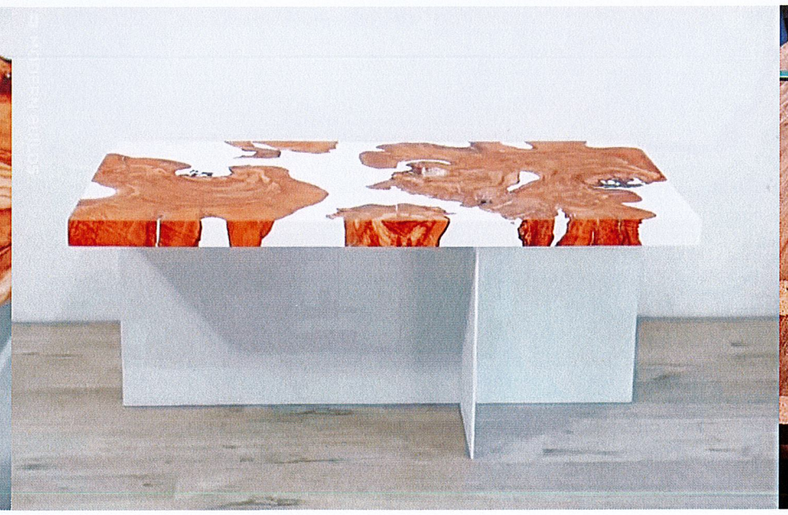
17222835J

CRITERIA 5

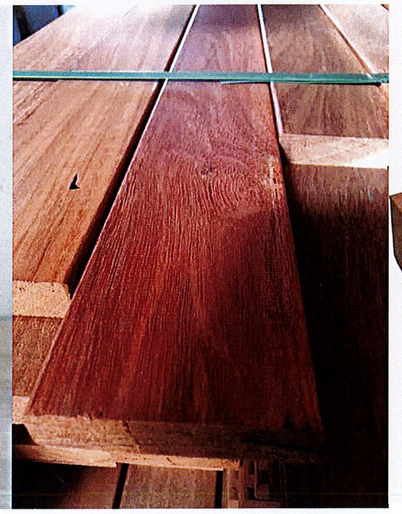
Material	Cost	Pros	Cons	Sustainability	Relevance to product
Resin	$39.97/2.26L VOC Free	- Comes in a liquid form, making it extremely easy to work with uneven shapes, ie wood - Is not affected by water - Comes in many colours and types	- Requires fast application - Has to be poured in a water tight, final product shaped mould	- Is made from a mixture of chemicals, however some epoxy resins are derived from plants, some greener than others - Is durable and long lasting	Resin would be suitable for the products as it provides a very modern element to the design, a request of the user, and is also easy to work with, being able to combine with most materials
Black Walnut	Expensive	- Few knots, with a very fine, straight grain - Rot, water and mould resistant - Few grain variations ie pieces line up - Easy to stain, works well with most - Hardwood (more strong and durable) - Is not known to suffer from warping	- Being a hardwood, it is harder to work with, and will blunted and wear machinery faster - Is an expensive wood, pressuring budget - Is a soft hardwood, durable, but not as durable as others, (oak, maple, ash) - Janka hardness rating of 1,010	- Being a hardwood, it is not sustainable by definition, as the tree doesn't grow back within a humans life span - However, as it is a hardwood, it is more durable than softwoods, and is less likely to need to be replaced during the products life	Black walnut would suit aspects of the design, as it has a very modern, dark aesthetic. It also has a very even grain, with few knots. However, for a hardwood, it is not very hard, reducing its durability and lifespan. It is also not a local wood, increasing its carbon footprint
Merbau	$280-$320/sqm - decking	- Is a strong hardwood, making it durable - Has an expected life span of 40 years in outdoor use (decking) - longer indoors - Can be sourced from Queensland, lowering the woods carbon miles - Is very dense, making it resistant to denting	- Wood is mostly sourced from unsustainable tropical forests in QLD and South East Asia - Wood tends to bleed tannin, which stains - Changes colour as it ages - initially product will be different to later down the track	- Being a hardwood, it is not sustainable as it does not grow back fast enough to reach maturity within a humans lifetime - This particular wood is mostly sourced from South East Asia, where it comes from deforestation, as opposed to plantations	Merbau would be suitable for the design as it is a dense hardwood, increasing the products resistance to dents & scratches, increasing longevity. It can also be sourced from Queensland, reducing carbon miles, and helping our local economies
Spotted Gum	$7.20/lmt for 86 x 19mm plank	- Sourced from sustainable plantations throughout Australia - keeps footprint small - Has minimal tannin leach - Is more resistant to combustion - Is a very durable and dense hardwood - Has very attractive, usually wavy grains	- High oil content makes spotted gum resistant to many adhesives and glues - Only the heartwood (centre) is insect resistant, the sapwood (outer) is not - It is an expensive wood, particularly in slab form, putting pressure on budget	- Being a hardwood, Spotted Gum is not sustainable, as it doesn't replenish within a human lifespan, however Spotted Gum is sourced from plantations across Australia, which minimises the effect it has on the environment, and lowers carbon miles	Spotted gum would suit the design as it is a cheaper, locally sourced hard wood. It also has minimal tannin leach, reducing the chance of staining. It is also somewhat resistant to combustion, reducing the risk of fire should an electrical item spark/overheat or combust
Jarrah	$72/sqm	- Jarrah is a highly durable wood, with a very high density, increasing lifespan - It is also rot, termite and water resistant - Has a tight grain structure, which allows the wood to retain its colour for longer - Has very little tannin leach	- Jarrah has a limited availability - Typically sourced from old forests - Is a rather expensive hardwood - Is susceptible to Lyctid Borer's - Requires pre drilling for screws, increasing the wear on tools and labour required	- Being a hardwood, Jarrah is not sustainable, as it ages longer than a humans lifespan to regrow to maturity, and lives for around 500 years - It is usually sourced from very old forests, which won't grow back	Jarrah would be a suitable wood for the product as it is an extremely dense hardwood, being very resistant to denting, and also makes it very strong. It is also rot and water resistant, should something spill, and has a very tight grain structure, holding its colour longer
American Ash	$11.56/LM for 140 x 22mm decking	- Has visible growth rings, providing a unique look, perfect for visual applications - Mostly grown in sustainable plantations - Has a very aesthetically pleasing, bright colour - Contrasts well with darker wood colours, such as Jarrah and Merbau	- Only has a medium level durability factor - Due to uneven grains, planks may not line up, providing a messy look at times - has a shorter product lifespan of only around 20 years outdoors - Has large colour variations - may not match	- Being a hardwood, it is not sustainable, it doesn't reach maturity in a human lifespan - The wood is mostly grown in plantations however, which are more sustainable than chopping down trees from a forest	American ash would be relatively suitable for the design, however it does have some drawbacks. It isn't as dense as other hardwoods, making it susceptible to denting. It does however have a very bright white colour, and contrasting growth rings, which look cool



Wood suspended in white resin



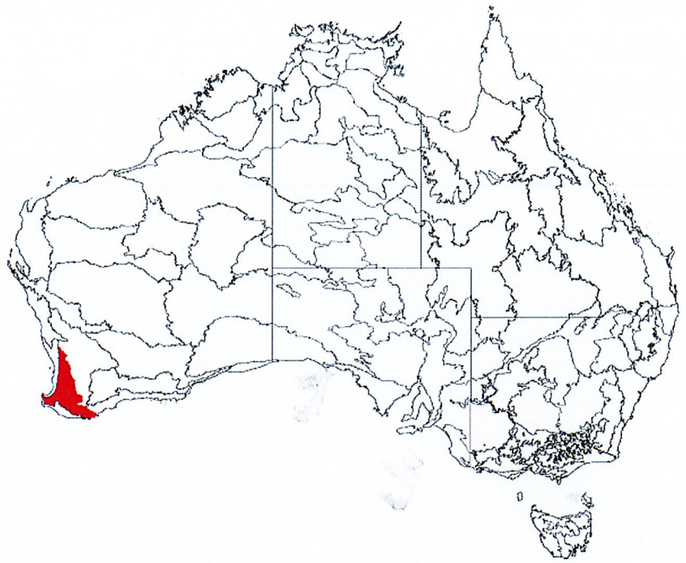
Wood and white resin table



Jarrah Decking

Merbau

Jarrah



Jarrah is a Harwood native to Australia, being found in the south-western corner of Western Australia. They only grow in the lateritic (iron oxide rich) soil, in areas where rainfall is exceeds 600mm annually. Climate change and human activities during more recent times has caused the growing area to suffer from dieback, causing the growing area to shrink, and putting at risk most of the region. Harvesting practices have since been improved, and forestry laws implemented, which has led to a decrease in the availability of the wood and the size available

Jarrah is a highly sought after wood for furniture, for several reasons. Firstly, it has a Janka Hardness rating of 8.5 kN, which is a measure of the amount of force required to embed an 11.28 mm steel ball into the wood to half its depth, leaving an indentation 100 mm2. With a Janka score of 8.5, Jarrah is one of the tougher hardwoods, making it ideal for frequently used items.

Jarrah also has a uniquely deep, rich colour, making it stand out against other woods. It is also unique in the fact that due to its incredibly tight grain structure, it suffered from very minimal colour loss over time, especially compared to other, similarly coloured woods.

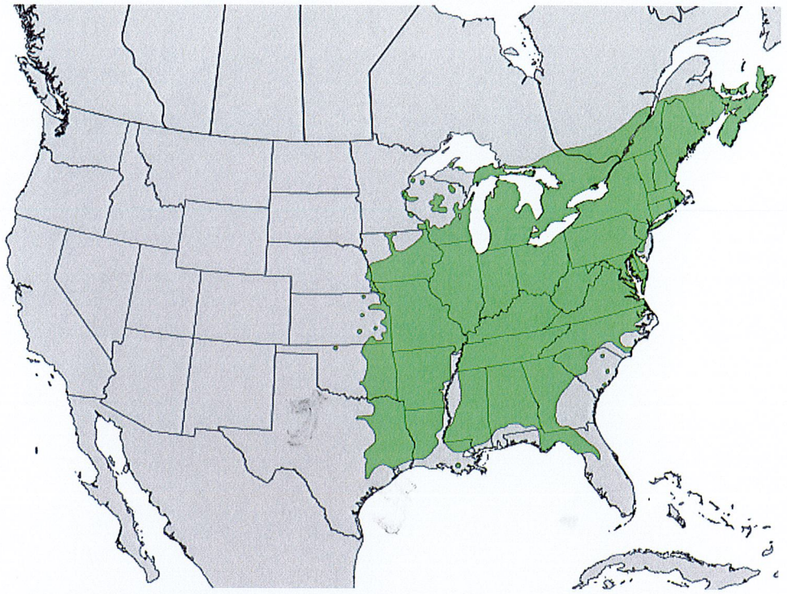
A final reason why Jarrah is used in furniture is its resistance properties. It is highly rot resistant, making it ideal for outdoor furniture, and is also very resistant to termites, making it a good wood to use in houses, as well as furniture.

Jarrah would be suitable for my project, as its high Janka score means that it is highly durable, and tough. This makes it perfect for the high use areas of the bedside table, such as the top table surface, where its dent resistance makes it ideal, and the lower shelf, where its strength makes it perfect for holding the sub.

Jarrah would also contrast extremely well with the room, which is mainly white, adding warmth and depth to the colour palette. It is also a suitable wood, as the tight grain structure holds the colour of the wood extremely well, and longer than most, which helps to increase the quality of the product over time.

Having a tight grain structure, and dark colour also makes the wood easier to maintain. Firstly, the dark colour would help to hide dirt and dust, reducing the cleaning required, and avoiding having marks stand out, such as stains. The tight grain structure also helps to stop dust and dirt from getting trapped in fine holes that can occur in other woods, where it is hard to get out, lowering the overall maintenance required.

American Ash



American Ash is a hardwood native to America, being found in the eastern and central eastern states. They grow in mesophytic hardwood forests, where temperature and rainfall is moderate most of the year round, with cold winters, and are deciduous trees. American Ash is a readily abundant timber, due to the sheer size of its suitable habitat, being logged throughout the growing region, and in specialised plantations.

American Ash has become an increasingly sought after wood for furniture, for several reasons. The first is its colour. American Ash has a uniquely bright white colour, with visible growth rings, and grain colour variations. This fits in with more modern trends of having lighter, brighter furniture, helping to drive up its popularity. It also has an uneven grain structure, providing unique patterns and detail.

A second reason why American Ash is becoming more popular is its abundance and availability. Being grown over such a large area means that there is plenty of it, meaning that manufacturers can have a wood that looks good, and suits modern trends, cheaper than other similar woods, increasing their profit margins.

A third reason is that American Ash only has a Janka harness score of 5.87 kN. This shows that American Ash is less resistant to denting than other woods, which indicates a lower density. This is good for producers as the lower the density of the wood is, the less work the machinery has to do, decreasing wear and operational costs. The flip side of this is that the wood isn't as durable as other hardwoods, and care would have to be taken to ensure the wood is only used in places where pressure isn't excessively concentrated to avoid denting.

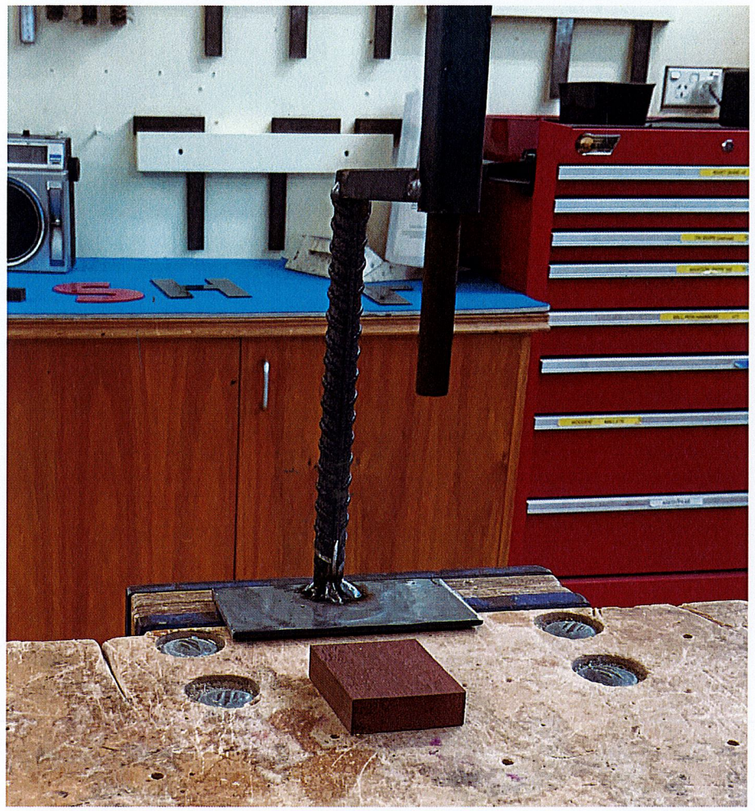
American Ash would be suitable for the less interacted with surfaces of the product, as it provides a strong, detailed contrast to the proposed Jarrah of the room. It's light colour would also help to reflect the light from the light strips back onto the sub, lighting up the white wood in the process, which would create an awesome looking effect.

If American Ash is used on the leg supports of the design, its lower Janka score wouldn't be a problem, as items such as mobile phones are unlikely to be dropped on it due to the location, and the overall compressive strength of the wood, as well as the fact that there will be six pillars, would still allow it to support and immense load without a problem.

Its lower density also means that it absorb more of the vibrations and sound coming from the sub platform, helping to isolate the top section of the table, to a degree, which would reduce the chance of vibration interfering with the electronics, as well as the moving components of the drawer etc.

17222835J

Hardness Test



To test the hardness of the three woods chosen for the test, a rig was set up, where a steel cylinder was dropped onto the wood samples through a square metal tube, to ensure the cylinder came down straight.

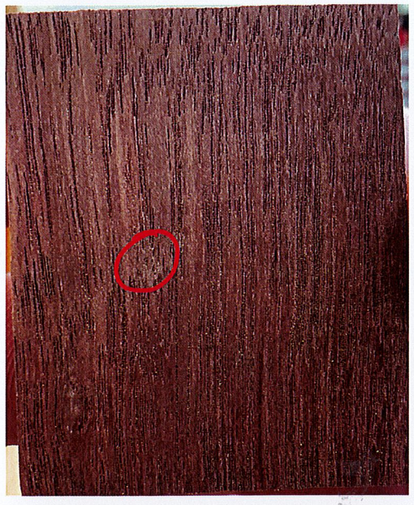
The cylinder had two differently finished ends. One end was filed down to make a rounded tip, which represents the corner of a phone, and the other end was left flat, with a 90° corner, which could represent a watch, box, or phone/laptop charger.

Three tests were done on the wood, one with the rounded end dropped normally, one with the flat end dropped normally, and one with the flat end being dropped at a higher speed.

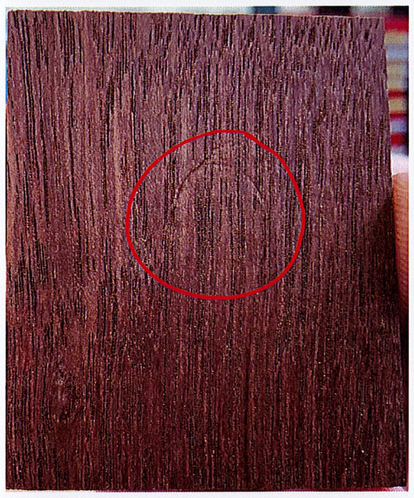
The metal cylinder weighs approximately 800 grams, which is far heavier than a modern phone, but allows us to test the woods to a higher level. The three woods chosen were Jarrah, American Ash, and Huon Pine.

17222835J

Jarrah



Test one, the rounded end dropped normal, barely left a mark on the wood, with it only really being visible from a side angle. This shows that Jarrah would withstand most drops and hits, without a problem. This would make it ideal for the more frequently used areas of the product.

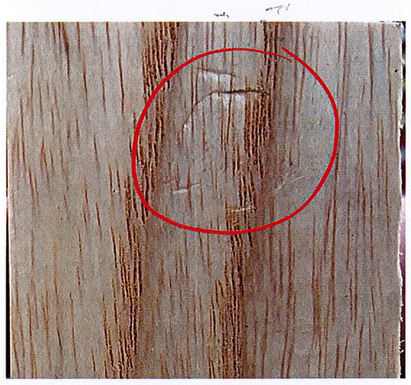


Test two, with the flat end dropped normally, showed that the sharp corner did leave a small mark, somewhat visible, however, not very noticeable from certain angles. This shows that while Jarrah is quite hard, it is not extremely hard, reflected in its Janka hardness score of 8.5

Test three, the flat end dropped at higher speed, left quite a reasonably mark, visible from most angles, large and deep enough to attract attention to itself. This test however is very unlikely to occur in real life, and is more about testing the wood to the extreme, instead of to what it will actually experience

American Ash

Test one, the rounded end dropped normally, did leave a dent in the wood, however it was not very large, and was not visible from all angles. This would be suitable for less frequently used areas of the product.



Test two, the flat end dropped normally, left a reasonably deep mark in the wood, which was significant enough to draw attention, and wouldn't be suitable for high use areas, or those subject to force

Test three, the flat end dropped at higher speed, left a large mark in the wood, deep enough to be easily spotted, highlighting the lower density of American Ash compared to Jarrah, and illustrating potential problems if the wood was used in high contact areas of the design

Huon Pine

Test one, with the rounded end dropped normally, left a significant dent in the wood, which was visible from most angles, and was large enough to be noticed from most angles. This shows that this wood is not suitable for use in the design

Test two, where the flat end was dropped normally, left a significant mark in the wood, with a ring marking the edges of where the cylinder impacted the wood. A deeper mark can be seen where the cylinder edge hit first, and shows the reduced durability and strength of the Huon Pine

Test three, where the flat end was dropped at higher speed, left a significant dent in the wood, with a deep ring visible around the full edge of the impact area. In this test, the cylinder landed flatter, leaving a more even groove in the wood, compared to test two, highlighting its lack of suitability for the design

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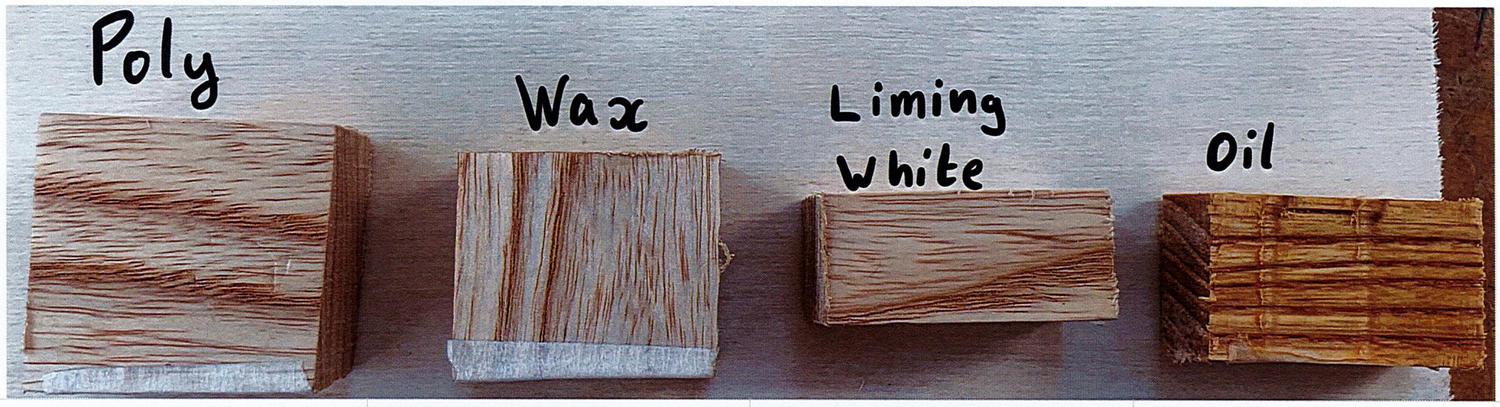
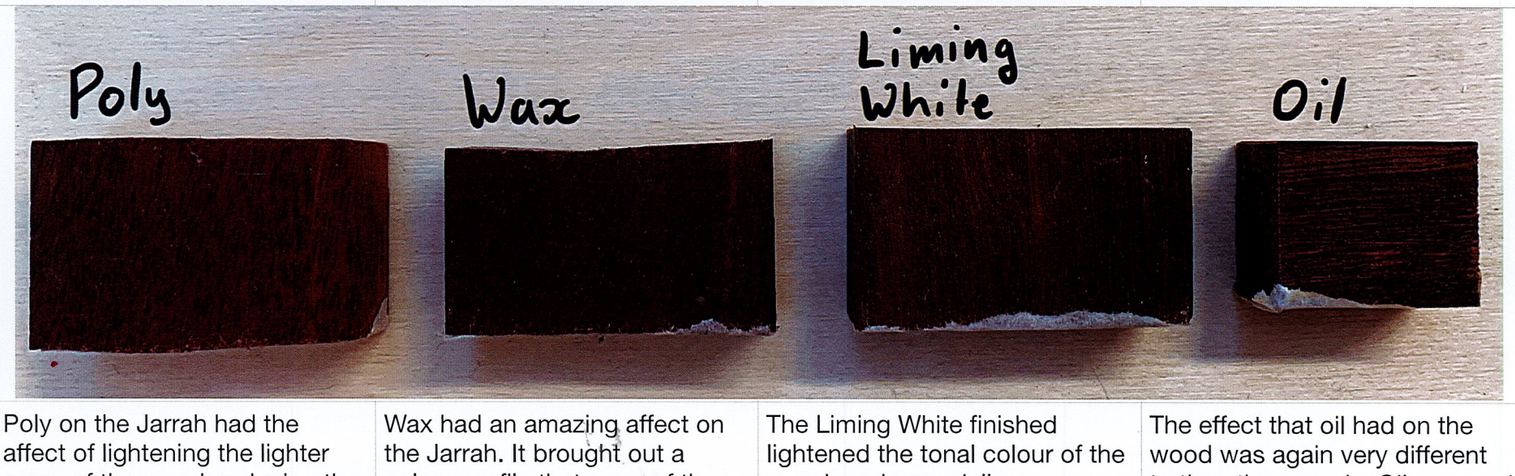
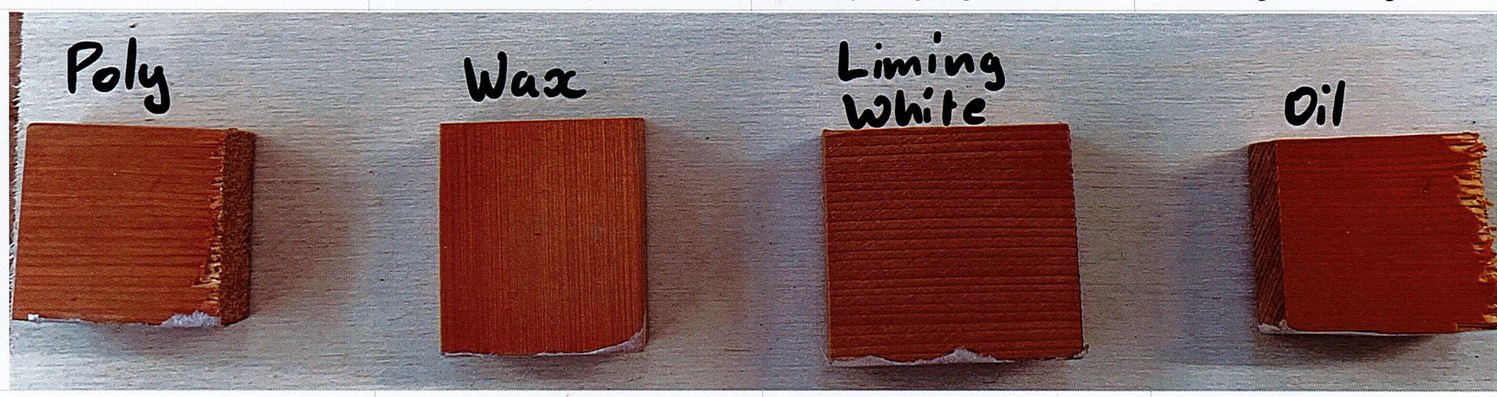


The effect poly had on the American Ash was to provide a smooth, slightly warm colour appearance. Poly gave a very flowing effect to the grain, and reduced the sharpness and harshness of the contrast between the two grain colours present in the wood, almost giving it the effect of becoming HD, instead of 4K for example	Wax had the affect of brightening the grain structure of the American Ash, turning up the contrast. This brought out and highlighted the small slivers of brown grain, whilst giving the white areas of the wood a very clean, cool colour. To use the tv example again, it essentially took the wood from HD to 4K, emphasising every detail	Had the effect of bringing a very smooth, soft white to the wood, almost blending the colour variations at the edges to provide a very smooth, flowing effect, reducing the sharpness of the wood to give it a very soft, slightly warm colour. It also muted the colour of the brown areas of the wood, giving a very gentle tone to the contrast	The effect that oil had on the wood was profound. Where the other three finishes were somewhat similar, oil took the white wood and made it brown, and turned the sections that were light brown to a chocolate colour. This completely changed the appearance of the wood, giving it a very old school look, warm look.



Poly on the Jarrah had the affect of lightening the lighter areas of the wood, reducing the saturation, whilst adding depth, darkening the darker parts, to create a very detailed, yet reserved finish. Poly removed the richness from the wood colour, but retained the fine detail, providing a very unique look and feel	Wax had an amazing affect on the Jarrah. It brought out a colour profile that none of the other finishes did. A purple undertone, with deep pink details emerged, providing an extremely rich appearance, whilst the finish remained semi-matte, creating a very high end, luxurious finish, perfect for the bedside table design	The Liming White finished lightened the tonal colour of the wood, and especially highlighted the lighter colour areas of the grain. This gave the wood an almost stripy finish, with the chocolate brown parts of the wood being contrasted by the lighter brown and dark brown/black grain lines, giving it a visually intriguing finish	The effect that oil had on the wood was again very different to the other woods. Oil removed the depth of the richness from the wood, and muted the strength of the colour, keeping the contrast, but changing how it contrasted. The oil brought out the purple undertone in the wood, bringing it to the front, contrasting it with a light brown



Poly on the Huon Pine had the affect of muting the colour variations, lightening them, reducing the contrast of the grain. It did however highlight the dent in the wood, darkening it and making it stand out more, highlighting the damage on the sample piece. Poly removed the rich undertones of the wood, giving a very clean, modern, yet cold aesthetic to the sample	Wax on the Huon Pine had minimal effect, retaining the natural colour of the sample, empathising the contrast only slightly. This allowed for a smooth appearance of the grain, with the colour variations visible and clear, without being too strong or harsh. It did however emphasise the change in colour tone from left to right, providing a unique affect	Liming White had the affect of highlighting the contrast between the grain colours, making the grain lines stands out across the sample. It also made the saw lines stand out immensely, particularly as the wood wasn't cut with direction of the grain, but rather at an angel to it. This left scratches, which the finish soaked into, allowing for the effect to occur	Oil on the Huon Pine instantly warmed the colour profile of the sample, darkening the light sections to be closer to the dark grain lines. This muted the colour variation and contrast of the sample, as did the Poly finish, but in the opposite manner. This gave the wood an older style finish effect, compared to the modern aesthetic of the poly.

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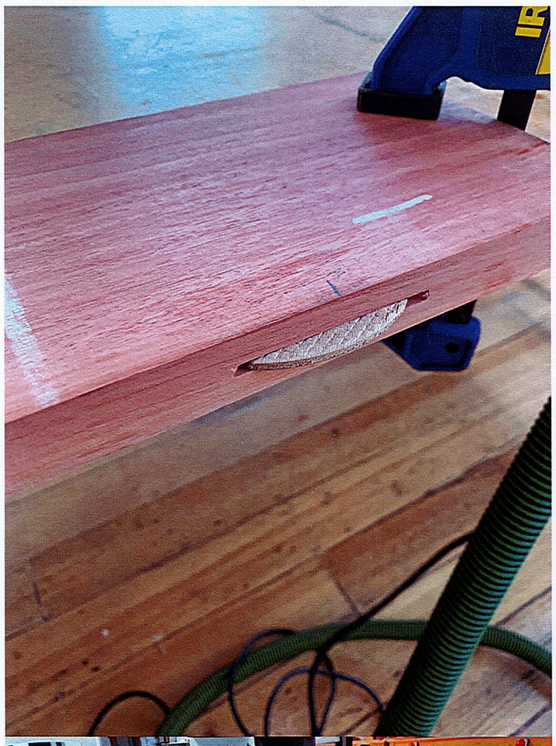
Process Testing



Biscuit Joining

Biscuit Joining was practiced on a spare piece of the Jarrah, being tested as a proposed method of joining the Jarrah boards. The benefits of biscuit joint are that it forms an incredible strong joint, the joint has virtually no flex in it at all. It also allows for some room for error, as the biscuit can slide forward and back a small amount in the biscuit cut, obviously before the glue dries. It also has the benefit of being easy to fit, as the dominoes fit slightly loose, before swelling when glued. The machine itself is also relatively easy to use, and is very accurate, allowing for multiple boards to be done without any variations in quality. A downside to biscuit joining is that one the biscuits and cuts have been glued, extreme care needs to be taken to ensure that the boards line up correctly, as the room for error factor can cause issues, as they can be moved when wet, but not after the glue has dried. The biscuit joining was done by ensuring the correct cutter setting were applied, clamping the board to the table, connecting the cutter to the Festool, checking for a second time the cutter lined up, and slowly making the cut, taking care to keep the cutter flat & parallel to the wood, and going slowly due to the density of the wood, reducing the stress placed on the cutter, reducing wear.

Domino Joining

Domino Joining was practiced on the same spare piece of Jarrah, in multiple directions, being a proposed method of joining the top section pieces together. The benefits of domino joints are that they form an incredibly strong join, due to the surface area of the join. They also have no flex at all, and create a very precise join, due to the lack of excess space between the domino and the join. This helps to create a very square join in the final product, helping to keep the top section the correct rectangular shape, with almost perfectly square corners. The big downside to the domino join however is that there is almost no room for error, due to the tightness, meaning that if a measurement is more than just every so slightly out, a new domino hole will have to be recut in a different location. The domino cuts were made by very carefully measuring how far down they needed to be, before the correct depth was set on the cutter, the Festool connected, and the cutter plugged in. Again, due to the Jarrah being a very dense hardwood, the cutter was operated slowly and gently to ensure the highest quality join was made, as well as minimising any potential damage to the machine.

Routing

Routing was again practice on the same piece of wood, for both removing the excess from the legs, and later to create the channel for the light cable to run through. The practice with the router was important, to help with the familiarisation of the machine, as almost all aspects are directly controlled by the user, with the machine being directed by the user, making straight edges harder to obtain. The router does however leave a very smooth finish, making a very clean cut through the wood, with a level base, perfect for sticking the cords onto. The downside to the router though is its difficulty to precisely control. To help with this, the material was firmly clamped to the table, so that it wouldn't/couldn't move, before the router was turned on, being held firmly when this occurred. Safety goggles were used, as well as hearing protection and an apron. The router was operated slowly, removing only a small strip at a time, to help improve the accuracy of the edge. It was moved with little force, to stop any damage to the machine from occurring, such as the blade snapping, again due to the density of the wood. Overall, the router works well, and suits the purpose well, when used carefully and appropriately.

17222835J

Model

For the model of the bedside table, Jarrah was used for the legs, and a light coloured plywood for the rest. This, combined with the hot glue used to hold it together made it relatively quick and easy to assemble. The only part of the model not to scale is the drawer handle - everything else is.

What I would change?

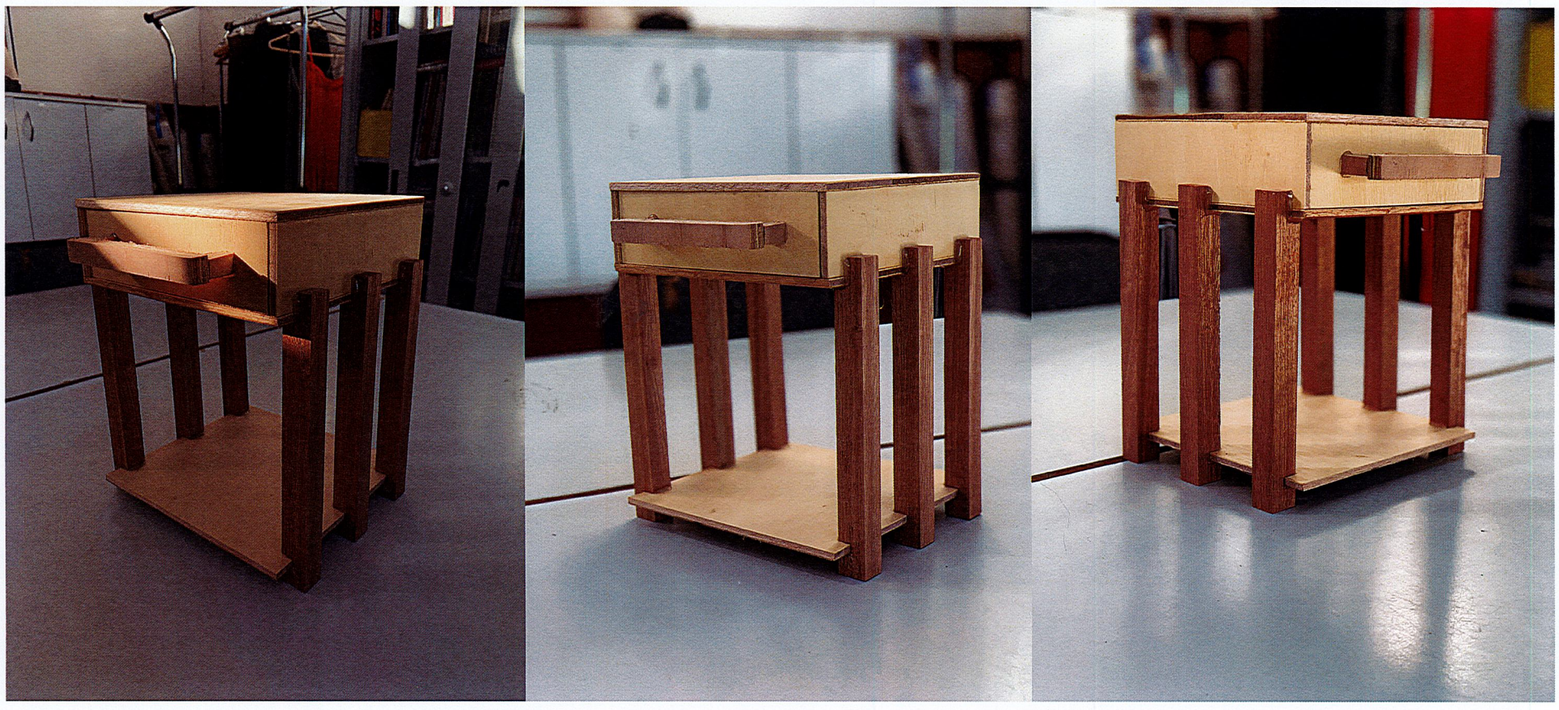
For the actual project, the colours will flip, with the legs being made out of a lighter coloured wood, American Ash, whilst the rest will be made the Jarrah used to make the model's legs. The colours and the drawer handle are the only two things that are going to change, everything else will be staying the same.

What does the user think?

I really quite like the model. It's different from the idea I had in my head at the start, but I think I like this one better. Once the colours are flipped, its going to look awesome, I can't wait

What would be changed so it could be mass produced?

The first thing that would be changed would be the materials, most likely being swapped out for something cheaper and easier to work with, probably a softwood, which causes less wear and tear on machines. The second thing to change would be the polyurethane used on the product, which needs to be left overnight to dry, so it would be swapped for something a bit faster. The third thing is that the overall complexity would be reduced, in areas such as the recess', forgone for a screw or corner plate



Risk Management:

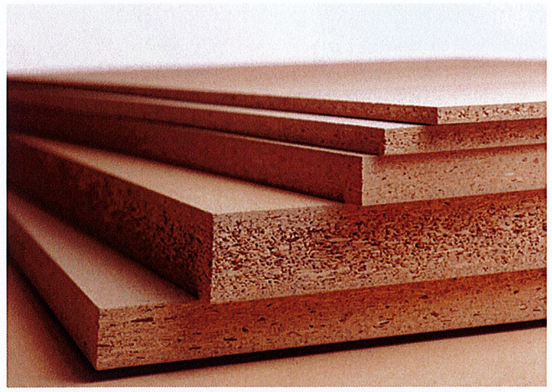
Machine/Tool	Hazards	Possible Injuries	Likelihood /5	Seriousness /5	Risk Management	PPE
Band Saw	• Impact & Cutting • Entanglement • Noise • Electrocution • Slips/trips/falls • Debris/dust	• Cuts • Tripping • Electrocution • Eye/ear damage • Scalping • Breathing problems	2	4	Ensure hair/loose clothing/loose objects/jewellery are secured & kept clear from moving parts when in use. Keep limbs & body parts clear when on. Consider push stick/guidance rail use.	
Biscuit Router	• Impact & Cutting • Entanglement • Electrocution • Noise • Slips/trips/falls • Dust	• Cutting • Electrocution • Eye damage • Dust inhalation • Ear damage	1	3	Ensure hair/loose clothing/loose objects/jewellery are secured & kept clear from moving parts when in use. Ensure users hands and body are kept clear from cutter when on. Ensure work is clamped, and appropriate guarding in use.	
Thicknesser	• Impact & Cutting • Electricity • Noise • Slips/trip/falls	• Dust inhalation • Electrocution • Entanglement	1	3	Ensure hair/loose clothing/loose objects/jewellery are secured & kept clear from moving parts when in use. Ensure guarding in use	
Router	• Cutting • Entanglement • Electrocution • Noise • Slips/trips/falls • Dust	• Cutting • Electrocution • Eye damage • Dust inhalation • Ear damage • Scalping	3	4	Ensure hair/loose clothing/loose objects/jewellery are secured & kept clear from moving parts when in use. Ensure users hands and body are kept clear from cutter when on. Ensure work is clamped, and appropriate guarding in use.	
Bench Saw	• Impact & Cutting • Entanglement • Electrocution • Noise • Slips/trips/falls	• Cutting • Electrocution • Scalping	1	3	Ensure hair/loose clothing/loose objects/jewellery are secured & kept clear from moving parts when in use. Ensure users hands and body are kept clear when on. Ensure work is clamped.	
Measuring Tape	• Cutting • Pinch point	• Cut	1	1	Keep fingers away from moving tape edge, let in slowly	
Hegner Saw	• Entanglement • Impact & Cutting • Electricity • Slips/trips/falls • Dust	• Cutting • Electrocution • Eye damage • Dust inhalation • Scalping	1	2	Ensure hair/loose clothing/loose objects/jewellery are secured & kept clear from moving parts when in use. Ensure users hands and	

Risk Management Cont.

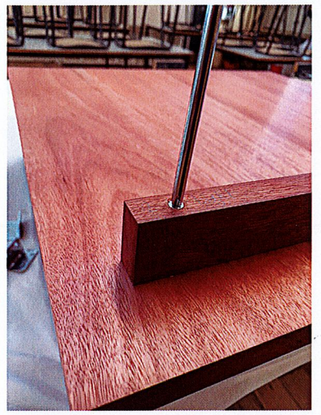
Hegner Saw Cont.					body are kept clear when on. Ensure work is secure.	
Wooden Mallet	• Striking • Crushing	• Crushing	2	2	Keep fingers and hands clear when using the mallet	
Chisel	• Striking • Cutting	• Cutting	2	2	Keep fingers and hands clear when using the chisel	
Mitre Saw	• Cutting • Striking	• Cuts to the hands	2	1	Keep fingers and hands clear when using the saw	 
Bobbin Sander	• Entanglement • Impact & Cutting • Electricity • Slips/trips/falls • Dust • Friction	• Electrocution • Dust inhalation • Friction burns	1	2	Ensure hair/loose clothing/loose objects/jewellery are secured & kept clear from moving parts when in use. Ensure users hands and body are kept clear when on. Ensure work is secure.	 
Bench Clamps	• Impact • Crushing	• Crushing	1	3	Ensure clamps are balanced and secure, keep hands clear	

17222835J

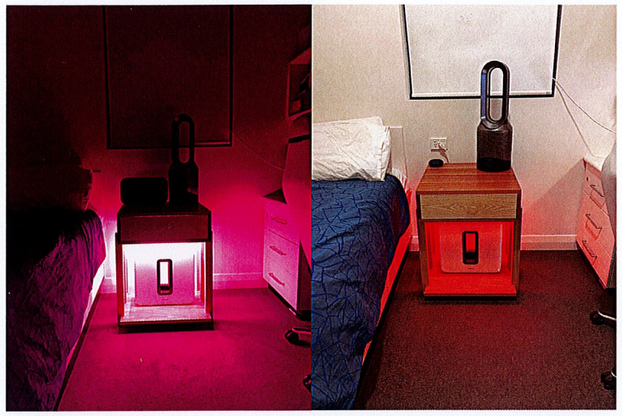
Changes for Industry/Mass Production



If my product were to be mass produced in industry, the first change would be to the materials used. Instead of biscuit joining together planks of Jarrah, a manufactured board would be used instead. This removed the risk of bowing, and saves days in production time. It also slashes the price to manufacture. These manufactured boards, ie chipboard, once cut to size would then be coated with a layer of Jarrah veneer, making them look good, and like the real thing, without the actual boards being Jarrah. This would also greatly reduce the weight of the product. The legs would also be made from a cheaper wood, such as pine, and instead of the push to open drawer sliders being used, normal ones would most likely take their place, with a handle screwed to the front of the drawer. This overall would likely be cheaper, and reduce the total number of parts (areas for potential issues, and therefore refunds & disgruntled customers) by removing the mechanism unit in the sliders.



Another change that would be made to my product would be the joining methods used. Instead of the labour intensive, time consuming and accuracy heavy methods used in the product, it would just be screwed together with a drill. The screws could easily be countersunk into the manufactured board, and once the layer of veneer has been applied over the top, you wouldn't be able to tell. By attaching the unit together this way, the time taken would be greatly reduced, as would the complexity of the build. This would allow for less skilled labour to assemble the product, saving money in wages as well. Screwing the product together wouldn't produce the same quality finish, as the screws could come loose, however it would allow for the total price of the unit to be reduced, opening the product up to a wider consumer base, and potentially making more money. It would also make the product easier to repair, as a new screw could be used, instead of having to saw the unit apart to re-domino.



One last aspect of the design that would likely change for industry is the technology. The mass produced product would likely have the necessary cut outs and groves to run the lights, with a recommendation to, but wouldn't ship with them included, in order to lower costs, and maximise profit. It does mean though that lights could be used in the advertising of the product, as the design supports them, helping to attract customers. The product could however come with speakers in the top of the back section, with the space cut through the board, as they are relatively cheap, and add appeal to the product. They are also easy to install (four screws) and a box containing the motherboard could easily by stuck underneath the top plate.