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I declare that the work contained in this submission is my own work and has not been taken from the work of others save to the extent that such work has been cited within the text of this submission.

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Applied Materials, Wood Finishing & Reproduction – TIM3003

Capstone Portfolio - The making of 'Suaimhneas'

by Stuart Hayes



Image 1 'Suaimhneas' Courtesy of Stuart Hayes

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Inspirational Piece ‘FAUTEUIL’ 1902 by Carlo

Bugatti (1856-1940)

Image 2 Courtesy of **(Sothebys, n.d.)**



Influential piece for ‘Windyhill’, Kilmacolm 1901, by Charles Rennie

Mackintosh (1868-1928)

Image 3 Courtesy of **(Hunterian Art Gallery, 2016)**



Influential piece ‘Pan-American Deck
Chair’ 2011, by Industry of All Nations

Image 4 Courtesy of **(Carlson, 2011)**

Introduction

From the earliest days of my studies in Timber Production Technology, my lecturers made many references to us looking towards the culmination of the course with third year's final 'Capstone' project. This was described as an opportunity to make a piece of period furniture or joinery pre 1950's which we were inspired by, which would also act as a major practical element of the syllabus, affording us the opportunity to exactly replicate, modernise or be inspired by a designer and their style, as well as it being a requirement for the completion of this course and a chance to showcase our learning experiences. However for me personally, my thoughts only turned to potential ideas for this project during my second year, as a direct result of an assignment module to conduct research into the many various furniture design styles and periods, their individual designs and respective designers.

It was during this time that I first came across the designs and works of an Italian designer called Carlo Bugatti (1856-1940), whose career bridged from the late part of the nineteenth century (1880) through to the early years (1910) of the twentieth century. Bugatti's Cobra chair (see Image 5) first caught my eye on an internet search of furniture designs and before I learned who created it, my opinion on first seeing its image, was that it was an aesthetically pleasing design with clean, modern and ergonomic lines. What surprised me even more, was learning that he had exhibited it, in the First International Exhibition of Decorative Arts held



in Turin in 1902. This piece by itself certainly wouldn't have struck me as being part the style of the Art Nouveau period in which his furniture is classified. Even though he is known to have said to the Queen of Italy when she congratulating him for his style furniture "Moorish": "You are mistaken, majesty, this style is mine!" (Musée d'Orsay, 2006)

Image 5 Cobra Chair by Carlo Bugatti ca. 1902, Courtesy of (Carnegie Museum of Art, n.d.)

My initial investigation into this piece led me to believe that it was shaped out of a single piece of wood, but through further research I found that he had completely wrapped the chair in a single piece of vellum. He had then drawn with pencil, painted and gilded the designs onto the vellum like an artist's canvas, so it was not surprising to learn that he had in

fact trained as an artist in the Brera Academy in Milan and at the Académie des Beaux Arts in Paris. (Pirro, 2010)

Having received the project brief at the start of my final year, I felt that there was not enough scope in the Cobra Chair to meet the brief of having at least five common furniture and joinery elements, such as Mortise and Tenon or Dovetail joints. So I once again looked at other designs of Bugatti and decided that a bare or uncovered version of his ‘Fauteuil’ armchair from the same exhibition in 1902, would better afford me the scope of meeting the required elements. I also felt this would both challenge me by the necessary practical work and at the same time affording me the experience of using different designs and finishing elements, while allowing me the chance to add an Irish slant in its adornment by using Celtic symbols and further naming it ‘**Suaimhneas**’ (pronounced *sue ive ness*) which is Irish for serenity, calm, tranquillity or relaxation. (Irishionary.com, 2015) Leading on from this point, I needed to make the decision of the wood I wished to make the piece from and in this regard I wanted to continue my theme of ‘finding a use for what might be otherwise considered



Image 6 and 7 Silver Birch tree in situ ca. 2011. Courtesy of Stuart Hayes

‘scrap’ which I used in my second year Cornerstone project. For this I sourced some copper from an old hot water cylinder taken from my hot press in combination with a 30 year old Silver Birch tree which was felled and cut up in 2014 due to it being only 1.5 metres from the external wall of a house. However the latter proved to be unsuitable as it had been cut up into blocks sized lengths and not seasoned correctly. After looking at the design of Fauteuil I deemed that sections of kiln dried commercially available timber to be too wasteful of material and therefore relouked at the at the design elements which I liked most and altered

my final design incorporating the design style of Charles Rennie MackIntosh and the Pan American Deck Chair (see Images 3 and 4). The addition of these style influences allowed me to alter my final design to incorporate remnants of oak flooring which I had left over after previous house renovations.

Context & Rational

The reasons why I chose to make a finished piece inspired by Bugatti’s Fauteuil chair (French for armchair) (see Image 2) were many fold. During my research into choosing a Capstone piece by a designer, his designs struck me by being, eye catching, inviting and aesthetically pleasing as well as artistic, and overall they struck me as being more modern in style than some of the contemporary furniture of that time. During the latter part of second year, I envisioned myself making a reproduction of Bugatti’s Cobra chair (see Image 5) because I liked its style and equally saw it as a challenge in learning and a chance of showcasing my production and craft woodwork skills.

My thoughts on making this particular piece changed at a later stage however, after I saw the list of twelve possible woodwork and other material techniques contained in the project brief (see Appendix 1), at least five of which had to be used in the manufacture of the artefact. For me, this was primarily due to the Cobra chair looking like it was sculpted from a single solid piece of wood, due to Bugatti completely covering his finished piece in vellum, thereby hiding any joints or techniques used to assemble it. I therefore felt that putting five of the listed joints or techniques into my interpretation of this piece might be seen as unnecessary to an observer and ultimately I would see this distracting from the sculpted look of the piece. It was at this point that I felt that his ‘Fauteuil’ design would allow me the opportunity to incorporate at least five of the required elements into my finished piece without detracting from its overall look. Another primary learning outcome of the module is to afford the opportunity of using and displaying the accumulated skills and learning which the course provides, but equally I saw this as an opportunity to add to my personal skill set through the challenges of using alternative mediums to which I had not yet been exposed e.g. replicate the artistic adornments which Bugatti had used to finish this and his other pieces with, in pencil, paint, gilt and metals. I envisioned pyrography on the bare wood as being a suitable alternative to pencil and paint on vellum. My thinking on replicating the copper disc on the

chair brought both feelings of dread and challenge in equal measure while at the same time an opportunity to use copper from a replaced hot water cylinder from home.

Other considerations reflected upon were the type and source of wood for construction of the piece. During discussions with my module supervisor and other course lecturers difficulties were highlighted to me on the use of the flooring due to their prefinished surface and the expansion grooving on the back. Discussion of alternative sources for upcycling brought into focus a felled silver birch tree (see Image 6 and 7), which had been cut down in the summer of 2014, but which hadn't as yet been chopped up into firewood. The aspects of using green timber for construction while seen as a learning opportunity were ruled out due to the many challenges this would pose not only in stability but in final finishing as well.

As a result of this organic development in my design process this drew me away from being able to make an exact reproduction using the methods and techniques of the time and more towards a modern produced piece inspired by the original.

Research

Designer – Carlo Bugatti (1856-1940)

Prior to my research into my chosen Capstone artefact, if I had been asked what the name Bugatti meant to me, my prior knowledge would have led me to say a sports car manufacturer and maker of the Bugatti ‘Veyron’ sports car. My early research into my chosen designer, Carlo Bugatti (1856-1940) soon revealed a direct family link to the aforementioned sports car company founder Ettore Bugatti (1881-1947) and his younger brother Rembrandt (1884-1916), an animal sculptor, with Carlo being their father, and his own father Giovanni Luigi Bugatti (1823-1880) also a sculptor. This also extended to a much longer association of this family name into various disciplines including sculpture, design, architecture, engineering, art and creativity of one form or other going back generations with links being claimed to descending from the 15th century Italian painter Zanetto Bugatti (Eaglesfield, 2013). My research also found that Carlo Bugatti had received notoriety in his own lifetime and into the present day as an Italian designer, architect, silver/goldsmith, manufacturer of furniture, a racing bicycle and musical instruments similar to a guitar. (enthusiastes-bugatti-alsace.com, n.d.) Many examples of Bugatti's work survive to this day

and are held in private ownership, private collections and other examples in museums, such as the example of an armchair which I personally visited in the Victoria and Albert museum in London in late September 2015. (see Image 8 & 9) This particular example which dates from the same period circa 1902 as ‘Fauteuil’ would have similarities in the stamped metal & painted Vellum but instead used turned and partly ebonised Walnut and silk cords as part of the construction. A further five examples of his works including the Cobra chair purchased in 2008 (see Image 5) are held by the National Gallery of Victoria, Melbourne, Australia. (ngv.vic.gov.au, n.d.) At auction individual pieces have typically made from five to seven figure sums in recent years. (Christies.com, n.d.)



Image 8 Bugatti Chair ca. 1902 Courtesy of Stuart Hayes Image 9 Courtesy of (V&A Museum, 2016)

Bugatti's Style

Even though Carlo is known to have told the Queen of Italy that his style of furniture ‘was his own’, it has been categorised as being part of the Art Nouveau (1890-1914) style of furniture design. The origins of Art Nouveau is hard to pin down but it is accepted by many historians as being inspired by a mix of the English Arts and Craft movement and mix of influence of Japonism with the decorative painting style of Synthetism and Cloisonnism, giving a

philosophy of applying artistic designs to everyday objects, in order to make beautiful things available to everyone. (ENCYCLOPEDIA OF ART HISTORY, n.d.) Carlo's training both as an artist & a cabinetmaker as well as his many other talents and interests, gave him the ideal mix of skills and talents not just to produce furniture but to create works of art out of his furniture. All of this knowledge and experience I feel gave him the confidence to mix materials, add artist embellishments and adornments all giving him the opportunity to stand out amongst his peers. His style was influenced by both Islamic and Japanese art as well as the medieval and exotic, with influences of nature and animal forms and representations with dragon flies being almost a signature emblem in his works. In terms of style he was very much ahead of his time, creating cantilevered furniture dispensing with the use of legs well ahead of the likes of Marcel Breuer (1902-1981)

Materials Bugatti Used

Given that both his designs of the Cobra and Fauteuil chairs were completely covered in vellum, with most references to these works focusing on the surface adornment materials rather than the base structural frame, it was through further research that oak as a base wood for these artefacts was established. Other sources established that Bugatti used various materials during his furniture designing career included both a wide variety and combination mix of materials, mainly working in exotic hardwoods such as mahogany, walnut, ebony, metals such as brass, copper, pewter and silver, while using vellums or silks as canvases for his painted, pencilled and gilded adornments. Shellac, gold and water coloured dyes were some of the additional finishes he used, with silk roping, tassels, ivory and marquetry with metals and mother of pearl being some of the many materials he utilised. (Eaglesfield, 2013)

Construction methods

An element of Bugatti's style was to cover the joints and construction methods used to assemble his furniture. A good record of the restoration of the armchair (see Image 8 and 9) by curators in the Victoria and Albert Museum revealed and documented some of the assembly and construction methods he used in the making of the chair.

‘The two axes are held in place by a series of turned wooden and pressed brass bosses which are applied to either end of the axes.’
and

‘In order to reverse the arms, the centre of the ‘X’ had to be dismantled. Fortunately, the outer bosses were relatively straightforward to remove from the axes, which were otherwise loosely fitting. Subsequent removal of the axes freed the ends of the arms and stiles, which were held in place by being shaped around the axes.’ ([Victoria & Albert Museum, 2011](#))

It is well known that Carlo Bugatti trained as a cabinet maker and architect and it is therefore reasonable to assume that he would have used his experience of these disciplines to construct his furniture, despite his preference to cover his construction methods and some of the base materials used. It has also been noted that he used techniques such as turning, as well as carvings and mouldings to replicate Islamic or Japanese, the style influences he brought to his designs. Carlo was also known for subtle design changes to his furniture which I believe would have kept his designs fresh and added variety for his customers.



The example of the chair in Image 10 is similar in style and finish to that of Image 9 albeit with subtle design and style changes. Most notable of these, is that the backrest is moveable, pivoting the change orientation of the chair.

[Image 10 Bugatti Chair c. 1900 Courtesy of \(1stdibs.com, 2016\)](#)

Joints

Having established that Carlo Bugatti routinely masked his furniture designs with his artistic embellishments and that very little of the documentation of his works refer to the wood used in the fabrication, rather focusing on the art of the piece, I have to assume that Carlo with his training and background used traditional cabinet making techniques and joints in the

manufacture of his furniture. As the later techniques of moulding with plastics and fibreglass had not yet been tried or adopted until much later into the 20th century by the likes of Charles Eames (1907-1978) and Ray Eames (1912-1988) and Eero Saarinen (1910-1961) respectively, his designs were a prelude to what could be achieved through the technological advancement in materials.

Tools used

My research into Carlo Bugatti didn't yield any sources of information about the tooling that was used to create these artefacts of furniture, therefore it is my supposition, that due to his background and training as well as the scale of his studio that Carlo would have used the hand tools and techniques of the traditional craftsman of the time, whether it was for the wooden, metal or painted elements of his designs.

Machines

Similarly, during my research, I could find no references to the machines Bugatti would have had at his disposal. However, as there is plenty of photographic evidence of his work, showing turning and pressed metals, it would be my conjecture that he had lathes and sheet metal working machines in his workshop as well as casting facilities, as evidence shows that he produced not only bicycles but metal sculptures too. Possibly he supplemented these with the odd piece of mechanical woodwork tooling, which he may have been able to invest in as he became established and generated revenue from his business, as wood working machinery started to be developed and marketed progressively from the 1850's with a lot of early mechanical planners and saws being more especially developed from this time. (Mansfield, n.d.)

Adhesives

My research did not result in yielding any evidence of any specific adhesive used by Bugatti in the manufacture of his furniture. However, from other research and course modular notes on adhesive developments, the only adhesives that were available to him in 1902 were traditional animal or fish glues along with rubber based and milk protein based Casein glue (1897), which would have been familiar to him from cabinet making processes. Phenolic resin based glue wasn't developed until after 1910 and with epoxy and polymer glues not being developed until much closer to the second world war period. (bsahome.org, 1991)

Methodology – Part 1 Artefact

Having identified the Fauteuil chair as my chosen design for my Capstone artefact and further researching the background of the designer and any information regarding the design and techniques employed by Carlo Bugatti in producing the original piece, I decided to create a bare wood replica of his design. My first task will be to design the seat based on ergonomic proportions and any information I can get on the original design of the piece and its dimensions. I will need to work out a materials list from this and a sequence of events and timescale for achieving all elements from sourcing, manufacture through to finishing which will allow me to produce the finished artefact by the end of the module. Another task which will be part of both the design and finishing stages will be to decide on the Celtic designs I will use to adorn both the copper seat back shield and the bare wood surface of the chair. To start on this process I will sketch out some examples of designs which inspire me from my research into available and traditional designs (see Appendix 4). I will then plan to follow the schedule of submissions dates as are laid out in the table of submissions which I see as will helping me keep focused and on track to the completion of the piece within the allotted time.

In my proposal (see Appendix 1) I have committed to make a bare wood oak chair which is inspired by the original. It will show the structure of the joints which for me is an important part of being able to showcase the cabinet making, joinery and bespoke wood machining skills that I have studied, learned about and practiced over the duration of the course. But I do not see this course as just something to be followed and just gotten through, I see it as facilitating me the opportunity for additional self-learning based on the nurturing environment of the college and the willingness already experienced of the its staff to facilitate, assist and guide me whenever possible. The two areas I foresee this self-learning as happening in are in the copper shield back plate and the pyrography. My plan will be to conduct research into these areas and practice on test pieces armed with the knowledge I gain through this research.

As for the other proposed construction elements of the chair I see my prior learning from throughout the course modules as being of significant importance for me being able to develop and produce an inspired design. For my proposed use of curved tapering work which

will be present in the whole structure of the chair but more significantly in the arms and backrest, the skills which I practiced in the joinery modules of the course in both the single curvature window, the double curvature of the wreath part of a staircases hand rail and a double curvature altar type table will be of particular relevance and use. My learning experience of mortice and tenon joints has been at the fore of all of the studied disciplines and I envisage it to be most useful in the joining of the arms of the chair by the arm posts to the seat as well as their use in the legs to the seat. I foresee that I may use a halving joint on the crossing of the seat legs and will have to look at ways of joining the two separate rails of the backrest into one and this would be an opportunity to use one of two possibilities either a halving joint or a bridal joint. These are all possible elements which Bugatti may have used in his designs, but chose rather to cover them all up with the vellum which he would later use as his painters canvas for his surface decorations. As I lack the artistic painting and design skills that Bugatti himself developed from his training in both the Brera Academy in Milan and later in Académie des Beaux-Arts in Paris (Williams, n.d.), I will not attempt to take on this form of chosen decorative medium for this important project piece, however I see my prior learning and training in the areas of veneering and inlay as being a method I can employ to create adornment on the chair. And while my only experience of burning wood to create colour variations was in sand shading of veneers to give a 3D effect on a sewing box lid which I included in another third year project, I relish the opportunity to attempt to burn on designs using a pyrography machine as it will be my first experience of this discipline of wood ornamentation and craft.

With regard to the style of the piece, the flowing lines and the transition from lighter to heavier sections appeal to my eye and I look forward to replicating this. I do foresee some difficulties being posed by the curvature on the finish and structural stability of the piece. This will be caused by the transition from long to short grain over the curvature of the grain, which would be lessened if I were to use steam bending, but I envisage that the sections are too thick and heavy to be able to employ this method in this piece. An alternative would be to use lamination of much thinner material sections to build up the separate curves, but having watched the development, adhesive challenges as well as jig clamping difficulties that using bent wood lamination caused some of the class members in last year’s third year capstone project, I will steer away from these techniques in this case.

I also foresee the need for strong and well executed joints in this piece due to the weight that not only the species of timber will bring but by its overall thickness of section. I may need to look at some additional ways of reinforcing some of the joints mechanically with the likes of nuts and bolts, the presence of which will then have to be disguised. The likes of cutting and fitting plugs of wood with a plug cutter to cover drilled holes will be one method that I could employ. Places I will allow for this type of mechanical fixing to be used will be in the halving joint between the leg cross over and in the connection between the arms and the backrest and maybe even the arm posts to the seat.

With respect to the sourcing of the materials once I have my materials list completed, I plan to source this material myself for timber merchants rather than obtaining this through the college. This will make available a better choice of materials and allow me to match colour and grain as well as the different plank section sizes of the wood for myself rather than just having to do this from a more limited supply which the college would have available.

Methodology – Part 1 Finish

The original Fauteuil armchair was completely covered in vellum as an outer finish, which was then adorned by Bugatti with pencilled and hand painted water colour animal caricatures of insects and flowers. For its finished look, the wood used to construct this chair was incidental to its appearance and only served as a base structure to support and stabilize the outer embellishments of paints and copper disc. Therefore, if the cheapest of cheap wood had been used and served this purpose, the observer would have been none the wiser. Equally there would have been no point in using exotic hardwoods such as walnut or ebony which Bugatti used frequently in the production of many of his pieces. On that basis I contend that Bugatti choice of oak as his structural material for this piece would have given the right balance of structural stability and strength with the more reasonable cost and availability of supply.

In my finish proposal ([see Appendix 2](#)), I plan to reproduce the chair without the vellum covering and instead leave the grain and character of the wood come through with additional adornments of Celtic symbols, using a combination of pyrography and beaten copper mounts. I have made these choices for the simple reason that I have to date, no experience of working with copper or pyrography, so adding the use of vellum as a finish would, I feel be

too much of a risk for a first time experience, whereas I have received training and experience on the course of finishing wood with lacquers, stains, paints, varnishes and shellacs.

As per my proposal I plan to use kiln dried white oak wood to construct the body of the chair. As a wood type, it has been used extensively through the different furniture periods of history, sometimes to a greater or lesser extent, with its use being very much dependant on the fashion of the time and the availability of other wood species, such as the exotic timbers from the tropics. With regard to the physical properties of oak, it is a one of the harder species displaying a high durability and a good resistance to water, which can see its use extend to the outdoors. There are two varieties of oak (see Image 11 and 12), one being red and the other white, with both having a relatively open grain but the later generally displaying a more attractive grain patterns and medullary rays.



Image 11 White Oak and Image 12 Red Oak Courtesy of (home.howstuffworks.com, 2016)

I plan to use the range of machines available to me in the workshops and including hand tools whenever necessary & or possible, to not only break out the wood but also to work on the design of it. I plan to use all guards fitted to the machines, safe working procedures and additional personal protective equipment, such as masks, boots and respiratory dust masks. After assembling, gluing and initially sanding the bare wood of the chair to a smooth finish, followed by a cleaning off with a clean cloth, I plan next to setup of a clean and well ventilated area in the workshop with access to power, a work bench and a stool to sit on for the process of using a pyrography tool to burn designs of a Celtic theme onto the surfaces of the wood. First I will choose the designs (see Image 13) from internet searches, art and book sources and plan their location on the chair. I will then replicate these designs by hand or printing on paper, followed by transferring an example onto a scrap piece of my base oak wood by tracing it on to the wood using a black carbon paper and practice using the different

attachments and various heat settings of the pyrography machine to achieve a good even burn and depth along the carbon outline on the wood. It will be important to guide the tool along the carbon outline of the pattern and not have the grain of the wood dictate the direction of the tool tip. Once the outline is in place it will then be necessary to fill in between these lines by burning the wood in a circular pattern aiming to achieve an even or gradually darker shading colour as required by the pattern. Any loose materials generated by the burning process will be cleaned off with a hover and any roughness sanded back lightly.



Image 13 Celtic symbol on White Oak Image Courtesy of (Angell, 2012)

I propose to finish the artefact using a combination of water based sanding sealer and satin varnish to be applied by brush. Before starting this part of the finishing process of the project all necessary materials and safety equipment are to be identified and gathered together for completion of the tasks. Also the manufacturer’s instructions for proper use and health and safety precautions with the use of their product will be familiarised and adhered to. These precautions and finishing setup will include a clean warm well ventilated work area, free from dust and other contaminants, Personal Protective Equipment in the form of a dust mask and disposable gloves, mixture of various sand paper grits, silicon carbide paper and sanding block and tack cloth. Other necessary elements include a range of sealers, grain fillers, edge sealers, water based sanding sealers and water based satin varnish as well as a place to clean, safely store and dispose of all waste materials generated with the use of all aforementioned products while following the manufactures instructions and recommendations on same.

The next step to be undertaken will be to lightly wet the surface of the bare wood with a damp cloth which will have the effect of raising the grain slightly. Following on from that, for

the next task the chair will be moved to the workshop to lightly de nib it in preparation for the finishing process to begin. For this 240 grit sand paper was put into a sanding block, then for personal health and safety from the exposure risks associated with breathing wood and finishing dust, a dust mask (see Image 14) will be put on over nose and mouth, before rubbing lightly over all surfaces, while all the time checking for smoothness by rubbing fingers over surface and any rough areas being lightly rubbed over again. Suitable coloured wood fillers will then be used to fill and make good any imperfections in the wood, this will be applied by a stiff scrapper and pressed in, then dragged and smoothed across with a flexible putty knife before allowing it to dry and being lightly sanded back to a smooth even surface. The piece will then be brought back to the finishing area where the surfaces will be lightly rubbed over with a tack cloth to remove any dust left on the surface. The next task to be undertaken will be the application of an edge sealer by brush to the end grain of the wood, focusing particularly on the thick sections which will be on the seat and chair arms (this will be done in a well ventilated area and the manufactures recommendations will be followed). An edge sealer is used to reduce the amount of stain or finish that is absorbed by osmosis into the wood, which if untreated will be greater when compared to that which the longitudinal grain on the majority of the wood surface will absorb. This will be then be allowed to dry before being lightly de-nibbed with 400 grit sandpaper.



Image 14 – Dust mask, sand paper and sanding block Courtesy of Stuart Hayes

Sanding sealer will be applied by a clean well laden (but not dripping) brush to the rest of the wood surfaces with even strokes and this will be allowed to dry before the surface is de-nibbed lightly with 400 grit sand paper, before being rubbed over lightly with a tack cloth to remove any remaining dust. The brushes will be cleaned with warm soapy water and allowed to dry after each of these applications.

After allowing adequate drying time, a water based satin varnish will then be applied by a well laden brush to all wood surfaces, making sure not to leave any bare patches, runs or drips. The finished dry surface will then be checked for imperfections and any missed areas. The finished surface will then be felt for any roughness, prior to being lightly sanded with wet 400 grit sand paper. It will then be allowed to dry before a second coat of varnish is applied as before. After drying, a waxed based polish will be rubbed over the surface of the wood with a clean cloth.

The copper shield can then be offered up to the chair back for size and position and this will then be hammered out with the chosen Celtic design prior to being assembled and fixed to the chair back.

Methodology – Part 2 Artefact

It was during my preparation of the design drawings which I needed to prepare for the start of the final semester that I came to the conclusion that I would need to change my final design of my reproduction chair, owing to a number of issues with the design which I hadn't fully considered. This decision was primarily due to the deep curvature of the wood which would have been needed to be used in the majority of the components of the chair. And this was more vivid to me by the backrest which was to run from the head of the sitting occupant to their feet in one continuous piece. It only struck me at this point that Bugatti's use of vellum was an inspired choice in not only have created a canvas to paint on but that this would have allowed him to mask his most probable joining of a number of sections of wood to form his deeply curved sections. The experience I had gained in semester one's joinery task of producing a handrail wreath gave me an appreciation of the necessary section of wood that is needed to create a double curvature piece on of a single piece. Apart from knowing it would be more expensive to get such a large piece a lot of which would have to be cut away as waste it would have most probably required going directly to a saw mill rather than just a timber merchant whose may not have such plank sizes in stock. On reviewing these issues, my course supervisor suggested that I take the particular elements of the original chair design that I most liked and to alter my design to incorporate these while at the same time eliminating the problem deep curvatures.

The design aspects which I particularly liked about the original were the copper shield and the high back rest and the enveloping shape I saw that the chair design giving the occupant. The conclusion I came to was that I needed to reduce the curvature and lighten the section of wood used to eliminate these material difficulties. I then started to quickly look at other designers of this era whom I had seen others students replicate over the duration of the course. Charles Rennie Mackintosh was the one designer who stood out for me with his many chair designs using a combination of light timber section with high back (e.g. see [Image 3](#)). I then also remembered a fold up deck chair made up of many individual lath type pieces held together with rope, which friends of mine living in Finland had given me to sit on in their garden a couple of years ago. My subsequent investigations found out this was called the Panamerican deck chair (see [Image 4](#)), which like the Windsor chair has been around for some time in one form or another spread across the countries of South America and beyond, and similarly isn't attributed to any one particular designer. My new design formed reasonably quickly in my head and my thoughts then also turned again to my being able to use my remnant flooring as a base material. With all this I sketched up a design based on the longest length of wood floor plank available and the most economical amount of laths based on the best thickness to width ratio (and the presence of expansion grooves cut into rear face of the boards) I could get from these boards.

My next step was to go to my home workshop (aka the garden shed) and to make a half size (1:2) scale model of my alternative design (See [Image 15](#)). This proved invaluable as it not only showed that the imagined design was possible but how the separate structural piece would interact as well along with the idea of using the variation on the natural colours of the wood as part of the finished design.



[Image 15](#) – Scale model of Suaimhneas Courtesy of Stuart Hayes

I next started to work on a sequence of events for its manufacture and breakout list of materials that would be required and identified the machines and processes that were necessary to go along with these. The machine I had envisaged using the most in making a copy of the Fauteuil design was going to be the bandsaw for the generation of the rough cut out of the curved components. However with the altered design I saw the band saw having an equal role alongside the necessary inclusion of the drum sander to remove the pre-finished cellulose lacquer from the boards, the panel saw to cut the boards into strips and the router to house the backrest laths and the belt sander to shape the armrests and posts.

Time tests were conducted on tanalising sample pieces of oak in a sealed plastic bag with liquid ammonia placed in a saucer. (note this was done in a well ventilated and cornered off area while wearing gloves, face mask and goggles) From these tests, 48 hours was the time deemed to give an adequate colour difference.

The sequence of events I used to create this artefact are detailed as follows on below and supplemental to this I kept a photographic record as an accompaniment to record and keep a backup of these (see Appendix 5).

NB. These instructions assume the reader is familiar with language, descriptions, machines and techniques utilised and are only meant to be a guide for a competent and suitably experienced person to follow. Neither are they meant as a guide to personal Health and Safety, but it is advised that best workshop practices are always followed and the proper use of machines with their fitted and correctly adjusted guards, along with the use of personal protective equipment to protect against the likes of noise, dust, fumes, chemical splashes on skin or eyes and debris/material impact. Further that the proper securing of work pieces by jig, clamps or bench vice should be observed and no wood materials below 300mm in length should be passed through a machine unless it is specifically designed to do so. Finally further information on best practice and the Irish regulations relating to Health and Safety can be found on the Health and Safety Authority's website and more specifically to the publications and guides at the following website address:-

http://www.hsa.ie/eng/Publications_and_Forms/Publications/General_Application_Regulations/Guide_to_the_Safety,_Health_and_Welfare_at_Work_General_Application_Regulations_2007.html

Please note: For image numbers quoted in the following sequence tables refer to Appendix 5

<u>Seq. no.</u>	<u>Description of making the chair's wooden parts</u>	<u>Image</u>
1	Identify necessary number of planks per cutting list and sand off pre-finished surface coating. (Additionally sand off expansion joints on rear of boards to eliminate these gaps in seat)	24-25
2	Rip boards for backrest into laths, removing tongue and groove and cutting with saw aligned to cut along expansion cut on back of board to maximise uniformity of width achievable	
3	Run laths through thicknesser to create uniform widths and then sand each individual piece to remove any rough edges or machine marks	26
4	Dry assemble 3 layers of boards for seat, balancing grain to reduce subsequent effects of cupping and movement. identify each piece its orientation and layer	27
5	Apply PVA glue to one edge of each layer of board and then rub joint these before clamping these in separate layers , cleaning off squeezed excess and leaving to cure	28-29
6	Prepare hydraulic press by re heating and putting in paper to catch excess squeezed glue. Before spreading PVA glue between each correctly oriented layer and starting curing of same under pressure for 15 minutes. Then leave flat to fully cure before cleaning off excess glue and running through drum sander to level off seat faces	30-31
7	Glue and clamp board for arms together, clean and level as before	32
7a	Half of the backrest laths were placed in a sealed waste pipe for fumigating for 48 hours using ammonia to darken the natural tannins in the oak to create a colour contrast between these and the untreated laths.	33
8	Identify backrest laths and arrange on a suitably sized MDF board	34

	(having been pre-marked with a centre line along its length) to be used as alignment setting out jig. Note: Overhang end of laths beyond jig to allow for trimming as per seq. no. 15	
9	Align laths from jig board centre and central lath of backrest. Fix spacer blocks between laths of backrest to evenly space laths over required base dimensions and on the outside at top and sides.	35
10	Fix a clamp to the laths at top of the backrest	36
11	Clamp the meeting point of the shorter and longer laths and mark a square pencil line on the jig board as reference for drilling a 8mm diameter hole through the centre of the laths approx. 25mm down from the at the top of the shorter laths. Use the square pencil line to set the angle on the sliding mitre gauge and transfer this across top of laths before drilling the 6mm hole through the laths	36-37
12	Cut and thread through a slightly longer length of threaded bar and put on washers to end before screwing on nuts and gradually tightening the nuts on either side to squeeze the laths tight to on another. Repeat this step at the top of back rest with 6mm diameter drill bit and blot together with suitable length of 6mm threaded bar.	38
13	Place and fit suitably sized spacer blocks at bottom of laths	39
14	Prepare suitably sized spacer blocks for loose placement between squeezed laths below shield level	39
15	Move jig with laths over edge of workbench and secure in place with screws before placing and aligning Festool 1080/2 saw track in line with bottom edge of jig board and sufficient lead in and out space for saw. Fix in place with clamps and additional support packing blocks.	40
16	Place Festool TSB 55 REB track saw onto track and set for smooth movement and necessary depth of cut and 5 degree angle for tilt of backrest. Before trimming laths of backrest to straight and level running saw across track. Having first removed top bolt, repeat these steps (with a square cut setting) for top of chair back	41-42
17	Fix known thickness baton dimensioned to depth of lath to base backrest laths with individual screws and reaffixing top bolt before	43

	marking position of laths and loosening packer blocks and removing backrest from jig.	
18	Calculate the necessary height of the seat support jig allowing for the depth of the lath fixed to base of backrest, the desired angle of the backrest (5 degrees), the seat thickness and the desired finished height of the seat. This is the distance to offset each side of the jig to be cut against after fixing to a base board before running through the panel saw. Alternatively this can be set (or double checked) using a protractor	43-45
19	Trim off the rough edges of the seat to the required dimensions, first cutting a 5 degree angle to match the rake of the backrest. Then assemble the two sides of the jig with suitable width bracings to support the seat close to its dimensioned edges. Check everything for square and alignment, the bed of the bandsaw was useful for this element. Then mark off the centre line of this jig to be able to align the position and fix the centre the backrest to this jig first using a strap and then pieces of boards screw clamped through the gaps in the backrest laths.	46
20	Centralise and clamp the seat to the backrest, before marking and scribbling the positions of the laths on the seat edge. Again seating this on the bed of the bandsaw to help improve levelness	47-48
21	Remove the seat from the jig and place in a bench vice before marking of a squared line off the scribbled to the depth the backrest lath will be housed into the seat	49
22	Prepare a routing jig to be used to support the router while the seat is being routed out for the housing of the laths. This jig has to be assembled with the 5 degree rake of the seat back to be accounted for. The panel saw was set at 5 degrees create this in the component parts.	50
23	Sleeve the router jig over the back of the seat and align before clamping in place in the bench vice and additional support clamps. before transferring the earlier scribed marks of the backrest laths on the seat back	51

24	Fit the plunge cutter 12.7mm to the router, which in this case was the Festool OF 200 EB. And create a setting guide template (which will be matched to the cutting edge of the router bit) using a piece of clear acrylic and a straight edging lath. A plunge cut into this gave the position of the router bit which was then scribed into the acrylic and was then used to align the cutter to the scribed marks. A board sized to the plate width of the router was used ensure parallel setting of the opposite edge of the router guide prior to it being screwed and clamped in place. This then acted as a track for the route to follow the scribed lines.	52-53
25	Set the maximum depth of plunge cut under the routers plunge cutting guide and run this through a test piece to ensure proper alignment and depth of cut is created by the jig. Then progressively plunge cut out the housing up to each of the housing lines. An off cut piece of lath can be used to check the accuracy of the cut and fit	54
26	Remove the seat back from the router jig and the position and fit of the backrest was checked and any necessary trimming carried out by trimming by hand using chisels. Using a carving chisel additional glue space was grooved into the inside edges of the housings to limit chances of glue starvation of the joint	
27	Use a dowel marker pin to position an aligned dowel into the edge of the underside of the seat with the backrest and the seat support jig. These would be subsequently removed while later shaping the seat.	
28	Reconfigure the router support jig by rotating one of its sides by 180 degrees and squaring the top edge to that of the other side in order to create a squared off support for the Festool DF 700EQ Domino XL. Use this to cut addition supports by domino (holes for 10 x 1000mm dominos) which adds additional structural support to the backrest by tying the shorter laths of the backrest to the seat.	55
29	Adjust the Router template edge guide to act as the domino marking guide, by first matching the domino marking lines on to the wood and then positioning the domino against these before plunge cutting	56

	through the acrylic into a piece of scrap material. Before setting the depth stop and using this guide to plunge into the body of the seat in the appropriate seat housing slots.	
30	Measure the position of each of the dominos from a reference point, say the underside of the seat and use this information to cut the domino holes into each of the corresponding backrest laths. Note to allow for the 5 degree rake of the seat back. This can be done by making the domino cuts slightly wider (1-2mm) or using a 5 degree wedge to correct this. Remember to adjust the plunge so as to stop short of coming through the back face of the lath	
31	Check the alignment of the seat dominos to the backrest before shortening the dominos to required lengths	
32	Mark out the final shape of the seat and use the bandsaw (set table at angle if required) and cut close to the mark line to allow for evening out with a belt sander and finished by, block plane and hand sanding	
33	Cut out a template for the shape and size of the arms which is needed to fit the size of the seat and even out with sanding to a smooth flowing shape. Mark out the desired position of the armrest on the seat edge and cut out the halving joint. Then use the narrow end of the arm template to mark out the rough shape of arm post for one side of the chair coming from a square edge and flowing out and up. At this square edge mark out the necessary reciprocal housing to allow arm post fit into the seat	57-59
34	Cut out the housing and check for firm fit of arm post into the seat. Then check the marked out shape of this and see does it position the arms in the correct and ergonomic position to allow the occupant sit into the chair and adjust as necessary. Cut out shape of arm post on bandsaw and even out this shape. Then use this first arm post as template to mirror the opposite arm post. Cut housing in this post	
35	Fit both arm posts in position and offer up the arm to the back rest and align as necessary with posts. Adjust the height of the arm to match the design height and mark the position of the outside lath of	60

	<p>the backrest on its edge. Mark and drill the position of the nut of a 70mm cot and bed bolt and drill a 10mm hole to align with the middle of the backrest lath. Then drill a 6mm hole to meet this nut and place a 6mm dowel pin in this to mark the position of the arm on the backrest lath. Drill a 6mm dia. hole perpendicular to the line of the arm rest to go through the first two laths. Repeat to add two 6mm alignment/support dowel positions and drill</p>	
36	<p>Scribe the angle the arm rest makes with the arm post in its final position by supporting the arm off the backrest using the dowels and then cut this angle on the chop saw and double check this. Next mark the arm posts for tenons and cut out and marking where the arm needs to meet the tenon of the arm post and cut out this mortice in a longer length and check rough fit before scribing top of arm post cutting the tenon back and checking the fit</p>	61
37	<p>Mark the finishing position of the front and back legs on the underside of the seat. Cut deal legs to necessary lengths and rake angles and fit these in position to check the interaction. Mark the ends of these on the underside of the seat once happy. Cut the appropriate angles and rake on the legs to join to the seat and form mortises in the underside of the seat and drill out the centre material before cutting these mortises out and then cutting tenons to suit same.</p>	62
38	<p>Repeat the angle and rake of cut on the floor ends of the legs but cut oversize to allow for the baton thickness fitter to the underside of the backrest in seq. no. 17</p>	63
39	<p>Drill and bolt the front legs in their dry fit position and then with rear legs in place and held cramped, mark the position to drill for the bolt at crossing point of legs. Before then removing the bolt from the front legs and removing the outside front leg which will then allow the drilling a 6mm diameter hole through the centre of these three legs at their crossing point. The middle leg of these 3 can be further removed and an 10mm hole drilled through at the same angle to allow a piece of copper piping be sleeved over the bolt to hide the</p>	64

	presence of the bolt.	
40	Dry fit chair together and fully assemble all parts, followed by hand sanding through the grit grades to remove pencil marks, softening aris and any rough surfaces in preparation for finishing	65
41	Having applied the first coat of finishing it was decided that this process would be much better conducted in individual pieces. So the chair was systematically disassembled with each part being numbered in an inconspicuous place for easy reassembly.(Please go to Methodology 2 – Finishing for description of finishing procedures)	

<u>Seq. no.</u>	<u>Description of assembling and gluing chair together</u>	<u>Image</u>
42	Clear a area on the end of a workbench for the glue assembly to take place using a flat clean board as a base. To one side arrange all of the backrest laths, front legs and rear legs into final position order and separate groups for ease of fitting during assembly. Gather the nuts, bolts, washers, spanners, glues (Cascamite and PVA) mixing pots, stirrers, a range of clamps, damp and clean cloths and one side of the original seat support jig to be used the set angle of chair back correctly	66
43	Glue the dominos into the back of the seat with PVA glue	
44	Place the seat face down with the lath housing hanging over the edge of the bench. Next thread the bolt through the three long and two short middle laths of the backrest. Before applying PVA glue to the inside of the corresponding housings and domino holes. Fit these into place and use the seat support jig to set the correct angle of these laths to the back rest and clamp in place. Allow time for glue to cure before proceeding	67-69
45	Mix up Cascamite glue to be used to fit the legs in position. Spread this glue into the mortise holes in the underside of the seat and on to the tenons too, before then fit each group of legs (including threading all the threaded bars to clamp legs through, noting	70-73

	especially not to fit outside leg laths until cross over bolt has been fitted). Clamp as necessary and allow glue to cure	
46	Glue the arm posts to the seat	74
47	Tread the remainder of the backrest laths on to the threaded bar in their respective position order	75
48	Spread Cascamite glue into the mortice of one arm. Glue the two outer laths on one side of the chair in place with PVA glue, quickly followed by the dowels into the arm end before threading the cot and bed bolt through these laths and tightening the arm rest to this. Spread Cascamite on the arm post tenon and fit this in place. Repeat process for other arm. Clamp as necessary and allow glue to cure	76-77
49	Tighten up the two cot/bed bolts on the arm ends before dry fitting the last two remaining backrest laths in place. Feed the threaded bar through the top of the backrest and tighten the dome head nuts in place. Tighten up the open headed nuts on the shield height threaded bar (These loose will be subsequently held in place by the tightening of these backrest bolts). Double check the tightness of the leg bolt at this point too.	76-77

<u>Seq. no.</u>	<u>Description of making and fitting the chair's copper shield</u>	<u>Image</u>
50	The chosen design for the copper shield was drawn up with location and centring marks and printed out three times at full scale for these to be then used as the marking template	
51	A piece of MDF 300 x 400mm was cut and centre cross hairs marked on this, before the paper template was aligned and glued to this board	78-79
52	A 10mm round router bit was then placed in a router and this was used to guide the router by hand to cut the design out into the surface of the wood. Tip: mark the route to be followed with a marker to aid the correct following of lines	79
53	A carving chisel was used to cut out any tight corners the router bit was too big to get into	

54	Two pieces of 300 x 400mm sheet copper were cut to size. Each of the remaining three design marking templates had different parts of the design cut out with a scalpel knife and these were placed, aligned and centred in turn over the copper sheet and the voids were traced around to build up the markings of the design.	80-81
55	Then one of these sheets was placed over the wooden former and one edge of it was clamped to the edge of the former using welding locking grips. A planishing ball hammer was then places in the centre part of the design to be shaped into the mould and this was beaten with a hammer all the way around the design. From time to time as the design progressed the clamps were loosed and the design centred as the copper built up tension before re-clamping and flattened out any lifts or twisting. This was repeated for the second shield	82-85
56	The sheets were then cut from the rectangle to the ellipse using a pneumatic snips with approximately 10-15mm excess all around to allow the bending of it edge over the wooden shield backing support	86-87
57	The two suitable shaped and sized wooden backing supports for the shield were then mounted by screws to the edge of the outside laths at the design height. The outside edges of the shields were bent over to form a lip and when complete they were offer up to the backing support to asses fit and any necessary adjustments made	
58	Cleaning of the design outline marks on the copper was undertaken with mentholated spirit using disposable gloves and a clean cloth in a well ventilated area with goggles and a dust mask on. A forced extraction was set up to help draw the fumes away. It was then degreased in a bath of warm soapy water with a drop of ammonia added to degrease the metal. This was then taken out, dried and cleaned with a dry cloth and not touched again with bare hands.	88-90
59	A neutralising bath of cold water with added bread soda was prepared which would be used to stop the chemical reaction of the next step when the desire coloured patina was reached. A bath of warm water was prepared and to this eight drops of Liver of Sulphur	

	<p>was added and three small test pieces of copper were added at one minute intervals to test the various times needed to achieve the desired patina. In this case 10 minutes was deemed ideal. The shields were then fully immersed and after 10 minutes had elapsed the copper shield was removed and placed in the neutralising bath prior to being dried off with a clean cloth. Note: The warmer the water the quicker the reaction, however boiling water shouldn't be used as harmful sulphurous gases will be given off.</p>	
60	<p>The two shields were lightly clamped in place over the chair back before the width and length of necessary copper banding to cover the shield edges over was measured. These were then cut out at 5-7mm oversize and the edges hammered over to create a safety edge along its rim. As before these two bands were immersed in a new mix of the Liver of sulphur for 10 minutes (as it neutralises gradually over time when left in the water) The size of little copper slips needed to fit between the laths were also measured and trimmed to size (no safety edge needed as they will not be accessible once fitted) and these were aged as well to match patina before housing between the turned over edges of the shield.</p>	
61	<p>In the same way measured slips of copper were cut and measured to fit over the top edge of the shield where it passes the backrest and a safety edge added to the side to face out before matching the colour patina as before. These would be later fitted in place once the chair then fitted in place using copper coated panel pins. Before the bands of copper were fitted to the outside edges of the shield supports in the same way using copper pins</p>	91

Methodology – Part 2 Finish

Tests were conducted on sample pieces of the oak plank to see how the painted on satin varnish would highlight the contrast between the tanned oak. At the same time a sample piece of the chair wood was treated and finished with a number of coats of a water based Worktop oil produced by Rustins to compare it to the proposed water based varnish. After

these tests were conducted and compared, it was decided that the Worktop oil was the final finish to be used because it gave a better finished look. (see Images 16 and 17)



Image 16 – Variations in colour of fumigated wood with varnish - Courtesy of Stuart Hayes



Image 17 Worktop oils testing - Courtesy of Stuart Hayes

The dry assembled chair was brought to the finishing room, where it was wiped over with a tack cloth rag to remove any remaining dust before the Worktop oil was painted on by brush and the excess wiped off with a clean cloth within 3 to 5 minutes as per the manufacturer’s instructions. This was then left to dry before being reassessed. At this point the decision was made that it would be better to disassemble the chair and apply the finish to the surfaces more easily and it had be too difficult to apply an even finish in the space left between the laths of the backrest and the chair legs. The chair was taken back to the workshop where it was disassembled and the pieces sanded back to eliminate the contrasts between bare wood and areas with finish successfully applied.

Trestle tables were then set up in the finishing room and the separate pieces of the chair were laid out on supporting lath, before being rubbed over with a tack cloth and the worktop oil painted on and excess rubbed off by a clean cloth and left to dry as per instructions between coats. (see Image 18) Nine layers were applied in this way to the seat and arms, with six coats to all other surfaces. All of these pieces were then taken back to the work room where they were sanded using progressively higher grades of sanding cloths up to a buffer pad. (see Image 19)



Image 18 – Wood laid out for finishing and Image 19 – Finishing polish with range of cloth pads - Courtesy of Stuart Hayes

After the chair had been buffed up, reassembled and glued it was brought back to the finishing room where guilt copper was applied to the dome nut heads. First ESP (see Image 20) was applied by cloth to the nut heads and allowed to dry fully. Then Japan Gold Size (see Image 21) was painted on over this by brush and allowed to tack up for about forty minutes before the copper guilt leaf was dabbed onto this with a soft guilder brush (see Image 22 and 23) . A cotton wool was then used to lightly remove and burnish any excess leaf on to the nut.



Image 20 – ESP finishing and

Image 21 – Japan Gold Size - Courtesy of Stuart Hayes



Image 22 – Copper leaf offered up



Image 23 – Leaf being dabbed down by brush -
Courtesy of Stuart Hayes

Estimated Time Scale of Manufacture

Event No.	'Suaimhneas' sequence of events	<u>Timing (mins)</u>	
		Estimate	Actual
1	Build scale model of design	240	365
2	Gather and run all boards through the drum sander to remove pre finished floor coating	90	130
3	Rip out necessary amount of boards to form backrest and leg laths	60	95
4	Thickness laths to uniform size and follow up by sanding	40	85
5	Test fumigate base material with ammonia	30m over 24hrs	40m over 48hrs
6	Fumigating laths with ammonia	120m over 48hrs	180m over 96hrs
7	Glue layers of boards together for seat	80	130

8	Glue layers of boards together for arm rest	40	30
9	Prepare template backing board and spacers for backrest laths	30	125
10	Arrange backrest laths in colour, size order and necessary dimensions. Followed by drilling and bolting together	60	135
11	Cut top and bottom of backrest laths with track saw and fit holding baton	40	55
12	Make curved shaped template and breakout armrests	40	65
13	Make a jig support for the seat to rest on during manufacture	120	195
14	Strap and temporarily fix backrest to support jig, place on flat surface and scribe lath positions on to back edge of seat	60	85
15	Remove seat and prepare a router jig for cutting lath housings	120	185
16	Create a router guide jig to allow for accurate cutting of router bit to the earlier scribed lines on the back of the seat	60	145
17	Check fit of backrest into housings of the seat and make any necessary adjustments	60	80
18	Reconfigure router jig to be support for domino cutter	60	105
19	Reconfigure router guide jig to allow accurate positioning of domino cut on seat back	60	65
20	Cut domino positions in housed sections of seat	80	125
21	Cut reciprocal domino position in backrest laths	80	85
22	Refit backrest to seat and support jig	20	10
23	Cut out template for armrest shape and use to cut out armrests. Smooth shape armrests on belt sander	60	85
24	Drill out fixing holes for cot/bed bolts in arms and backrest.	60	50
25	Mortice and tenon the arms to the arm posts	100	150
26	Mark the position of legs on base of seat and cut and house legs as necessary and dry fit	480	760

27	Drill holes through legs at necessary crossing and intersection points	50	65
28	Give dry assembled chair a sanding and remove arris from edges prior to giving a first sealing finish	60	130
29	Disassemble chair and sand down and apply 6 to 8 finish coats by brush and cloth before buffing back and copper gilding nuts	300	510
30	Assembling and glue chair together	180	280
31	Print out shield template and fix one to piece of MDF and hand rout design with 10mm diameter round head bit	60	85
32	Cut out two 300 x 400mm blanks of copper sheet and in turn clamp and beat design into copper	240	180
33	Mark out a cutting line approx. 10mm bigger than the finished shield size and cut off excess copper with pneumatic/hand snipes	20	30
34	Cut a lath thickness (e.g. 35mm) wooden blank to finished dimension of shield ellipse and round over the edges of this on blank.	90	120
35	Cut two sheets 4mm and 8mm to size of wooden blank. Place wooden blank up to backrest scribe and cut off edges as support for shield and sandwich between two sheets (cut out centre of sheet if design is desired facing inwards)	60	95
36	Clean copper of grease and patina shields with liver of sulphur	120	180
37	Use clamps to hold shields to back of chair and measure the width and length of the copper belt need to cover any exposed edges, cut and hammer safety edge on to it	120	150
38	Pin all of the copper to the shield backing support	120	140
	Total Times (mins)	3710	5525
	Total Times (hours)	~62h	~92h

Cutting List

DT 169 TIMBER PRODUCT TECHNOLOGY

Semester 1 2015 / 2016

Module : TIM 3003

Applied Materials, Wood Finishing & Reproduction

<u>No. off</u>	<u>Description</u>	<u>Length</u>	<u>Width</u>	<u>Depth</u>
7	Long backrest laths - Oak	1290	17	35
6	Short backrest laths - Oak	897	17	35
4	Front legs (i.e. Front underside of Seat to floor) Oak	650	17	35
6	Back legs (i.e. Back underside of seat to floor) Oak	590	17	35
4	Planks for arms and arm posts - Oak	800	110	17
16	Planks for seat - Oak	590	110	14
1	Support for shield - deal	400	300	35
1	Plywood sheet	400	300	4
1	Plywood sheet	400	300	8
2	Copper sheeting	400	300	1
1	Copper sheeting	400	100	1

Conclusion

I found this project both challenging and rewarding in many respects, with quite a few of the former being of my own making, in so much as that I seem to choose difficult designs. At the start of the process, I certainly hadn't fully appreciated the trials that making a replica of Bugatti's Fauteuil chair would cause both from the material and design process perspective. And it gave me an insight into a probable alternative reason for him covering the original chair with vellum and that it might just not necessarily been acting as a painter's canvas.

However having said all that, I found the encouragement and support of the college staff involved in delivering this course marvellous and their guidance helped me meet the challenges either head on or gave me the insight into getting around them. This project also gave me the opportunity to try mixing different things which I hadn't tried before, like the sheet metal work and fumigating, the latter being a slight disappointment, as it wasn't really

that effective in darkening the wood, I suspect probably due to the wood having been prefinished as flooring. Minor regrets are that there were some less than crisp joints on the finished piece, but I console myself imagining it as only a prototype of what can be achieved. Overall though I have to conclude that I feel very proud of the aesthetic look of my design and I'm very glad that I chose Carlo Bugatti as my inspirational designer for my Capstone project.

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Appendix

Appendix 1 – Artefact Proposal Brief

Module : TIM 3003

Applied Materials, Wood Finishing & Reproduction

DT 169 TIMBER PRODUCT TECHNOLOGY

Semester 1 & 2 2015 / 2016

Proposal Brief

Initial work on this module will start in June 2015, during the summer you will need to carry out some research and decide on whether you would like to make a reproduction of an item of Furniture or Joinery for your final year Capstone Project. You will have to put forward your choice in week 1 of your third year Capstone module. You will be presenting your Draft proposal to the class on week 3.

Chose an Artefact of Furniture or Joinery from Pre 1950 that you would like to reproduce.

Give some details of this Artefact, when it was made and who designed it, what period it dates from. Give the materials it was manufactured from and finish that was applied to it.

Give details of how you propose to make it. Will it be an exact reproduction, copying style, finish and traditional joints, using traditional methods or will you change the style, use modern methods of replicating joints, modern joints or finish or will you create your own unique piece using a historical piece for inspiration.

Your Artefact must have at least 5 of the list below

Mortise & Tenon Joints

Dovetail Joints

Mouldings (applied or solid)

Carving

Veneering

Inlaying

Rebates or grooves

Upholstery

Glazing

Turnings

Tapering

Hinging

Proposal

Semester 1 2015

Proposal to be filled in and submitted for feedback on week 3 also with PowerPoint presentation to be presented to the class on week 3 as well.

Chose an Artefact of Furniture or Joinery from Pre 1950 that you would like to reproduce.

Student Name Stuart Hayes

Name of Artefact 'FAUTEUIL' French for Armchair

Details of Artefact: When it was made and who designed it, what period does it dates from.

FAUTEUIL, 1902, was designed by Carlo Bugatti in the Art Nouveau period of furniture design

Give the materials it was manufactured from and finish that was applied to it.

Wood which research shows to have been oak, completely covered in vellum and adorned with painted and pencilled insects.

Give details of how you propose to make it. Exact Reproduction / Modernised

I propose to make a bare wood oak chair inspired by the original piece, which will show the structure and joints of the chair unlike the original which was completely covered by vellum.

Highlight the five main features of your artefact

Curved tapering work, Mortise and tenon joints,
stamped copper, pyrography, inlay and veneering.

Student Name : Stuart Hayes 30/9/2015

Appendix 2 – Artefact Finishing Proposal

DT 169 3rd year

Timber Product Technology

Semester 1 2015

Finishing Proposal

Select a finishing material for your Substrate:

Sanding Sealer followed by a satin water based varnish will be used as the finish material.

The piece will be made from oak preferably the white variety and will incorporate a stamped copper disc. As this wood has a quite open grain, wood filler will most likely be needed to fill the open grain pores to achieve a smoother finish to the touch and allow better light reflection. The varnish will give a more durable finish to the piece as well as a level of lustre which may be further enhanced with a wax based polish

What materials are required to complete the work:

Various grit Sand paper and sanding block. Paint brushes and rubbing cloths.

Also scrappers will be employed. Dust masks will be needed for the sanding process.

Application methods:

The piece will be sanded smooth and dust removed. Grain filler will be applied and sanded smooth. Sanding sealer will then be applied by hand using paint brushes and rubbing cloths. This will be sanded further and the piece cleaned of generated dust before it is varnished, lightly sanded and varnished again. A wax based furniture polish will then be applied finally by cloth

Workshop conditions necessary:

A warm, well, lit, well ventilated dust free workshop with access to clean water for cleaning up the tools used will be needed.

Health and Safety:

Dust masks will be employed when dust is being generated during the sanding process.
Water based finishing products have been specified for their reduced VOC gases and their reduced health and safety risks with use. However the manufacturers Health and Safety Instructions will also be followed for their products. The work area within the workshop should be kept clear and free of trip hazards and have a safe and secure area to store the finishing materials as well as the work piece.

Student Name : Stuart Hayes 30/9/2015

Appendix 3 – Schedule of Submission Dates

DT 169 TIMBER PRODUCT TECHNOLOGY

Semester 1 & 2 2015 / 2016

Note: All written work must be submitted through Safe Assign on Webcourses. Two copies of the glue bound Thesis work is to be delivered to submissions box outside general Office. You will be advised separately of submission dates for different components (see attached timetable).

Submission Dates (these dates are subject to change student will be advised on any changes in advance).

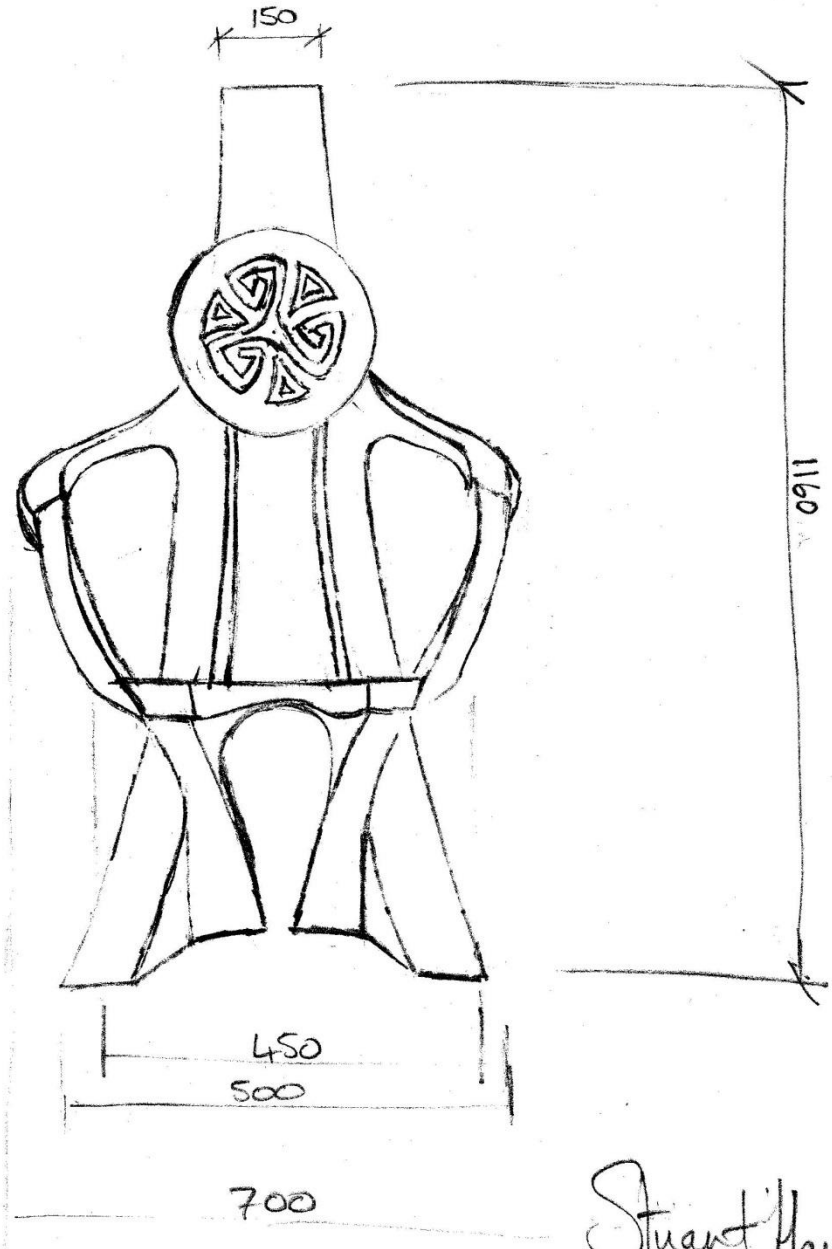
Unless stated submission is 4.00pm on the Friday of each given week.

Week No.	Task
	Semester 1
3	Oral Presentation of Proposal's duration 10mins with 5mins Q & A.
8	Cutting list to include all material necessary for production of artefact
9	Estimated time chart. Note: This chart is to be updated with actual time chart in final submission.
10	Chart showing machine requirements and duration. (if applicable)
12	First draft of Portfolio to include the following headings: Introduction Context & Rational Research Methodology Part 1- Artefact Methodology Part 1- Finish
	Semester 2
1	Cad Drawings: Final drawings showing overall sizes, detailed sections and component parts to include a 3D Cad drawing of proposed artefact. Drawings to be submitted in A3 Folder with cover submission sheet stating number of sheets within folder. Folder to be submitted to class lecturer on day one of practical class in week one of Semester two 2016.
12	Final written portfolio: Glue bound to include redraft of work submitted in semester 1 and the following headings: Methodology Part 2 Sketches Final Cutting list Estimated and actual time chart
13	Poster presentation: A1 poster showing the research, manufacturing and

	final artefact. Poster to include name of artefact and student's name and year.
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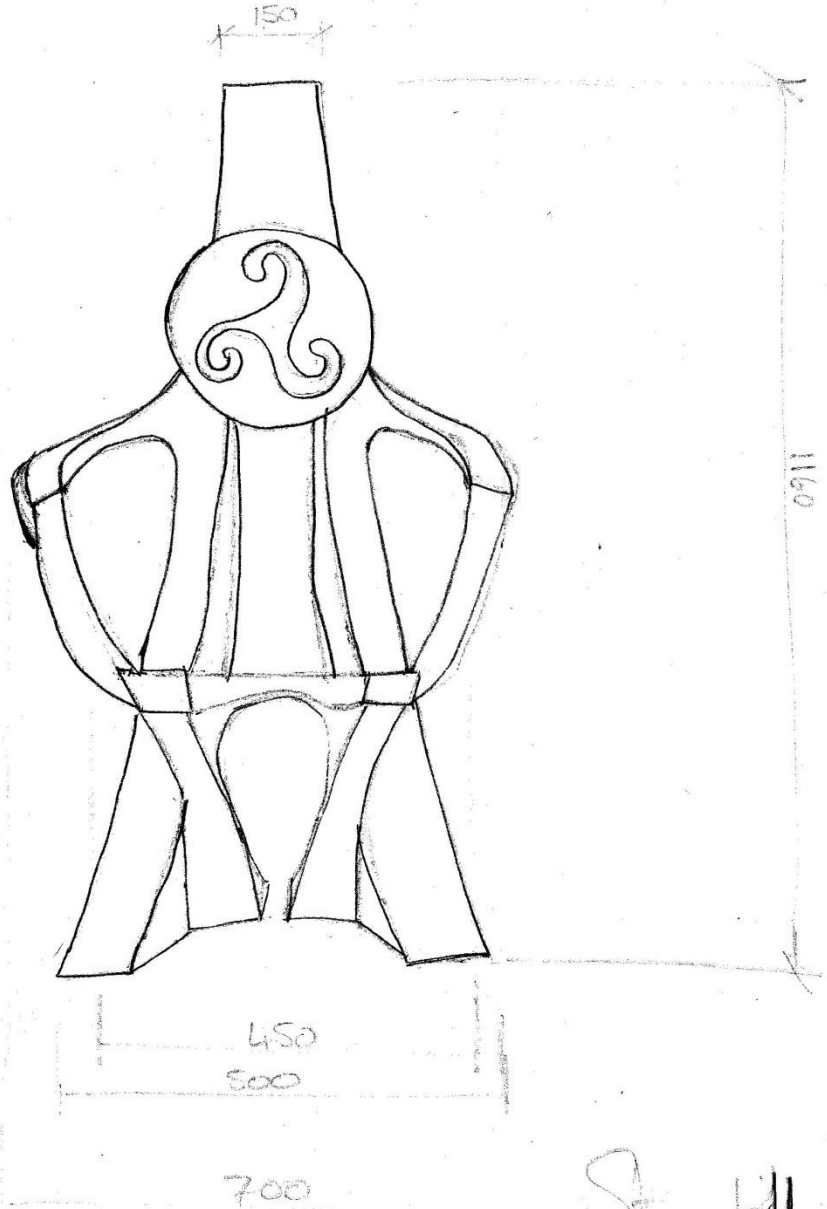
Appendix 4 – Design Sketches

'Suaimhneas'
By Stuart Hayes



Stuart Hayes
11/10/2015

'Suaimhneas'
By Stuart Hayes



Stuart Hayes
11/10/2015

The following is a visual process diary of the fabrication of Suaimhneas Courtesy of Stuart Hayes



Image 24 Selection of boards



Image 25 Sanding off pre finished surface



Image 26 Thicknessing boards



Image 27 Arranging layer of seat boards



Image 28 Applying glue for rubbed joint



Image 29 clamping seat layer



Image 30 Applying glue between seat layers



Image 31 clamping seat layer in heated press



Image 32 Gluing arm rests



Image 33 Ammonia fumigating



Image 34 Backrest laths arranged on jig board



Image 35 Spacer blocks



Image 36 Clamping and getting angle



Image 37 Drilling hole for threaded bar

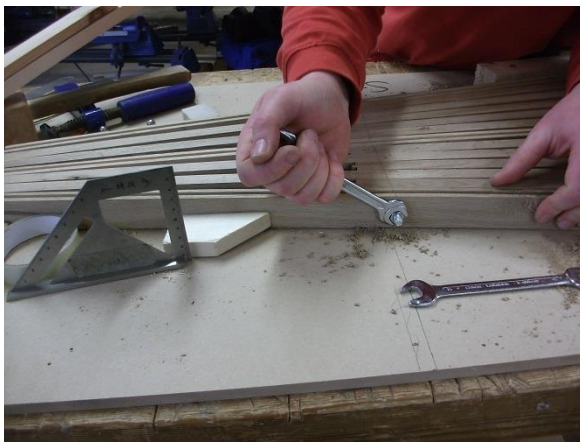


Image 38 Tighten bolt on threaded bar



Image 39 Spacer blocks



Image 40 Clamp on track for track saw



Image 41 Mount saw



Image 42 Cutting laths



Image 43 Baton screw fitted in place

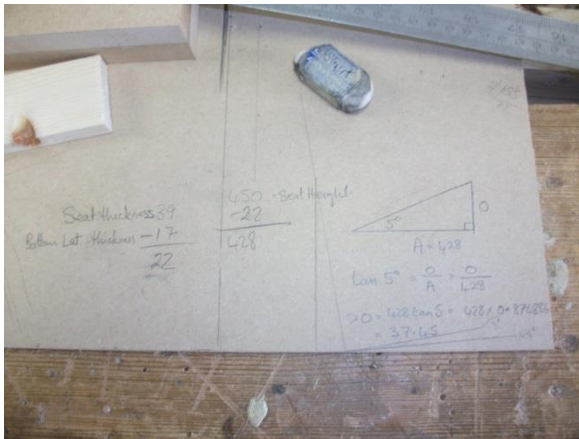


Image 44 Using trig to work out offset for jig

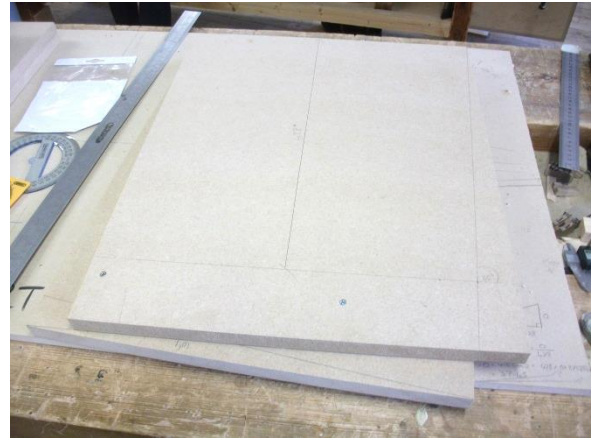


Image 45 Setting 5degree angle of cut for jig



Image 46 Trimming rough edges of seat



Image 47 Baton screw fitted in place

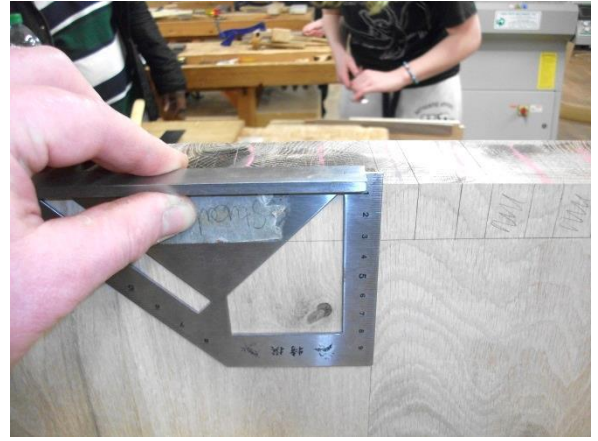


Image 48 Scribing lath positions to seat back Image 49 squaring these scribes to seat face



Image 50 Preparing router jig

Image 51 Clamping seat and router jig in vice

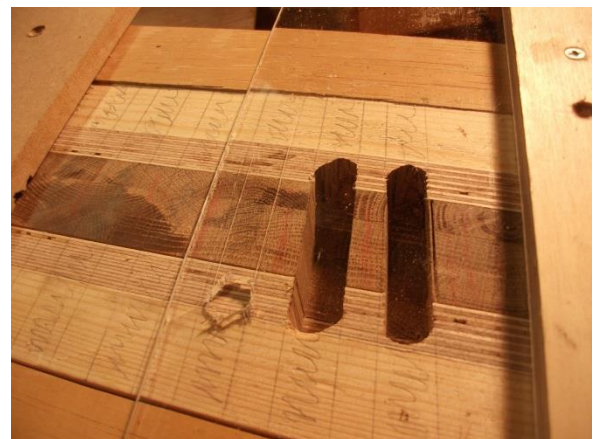


Image 52 Router and cutter

Image 53 Marking jig for router cutter

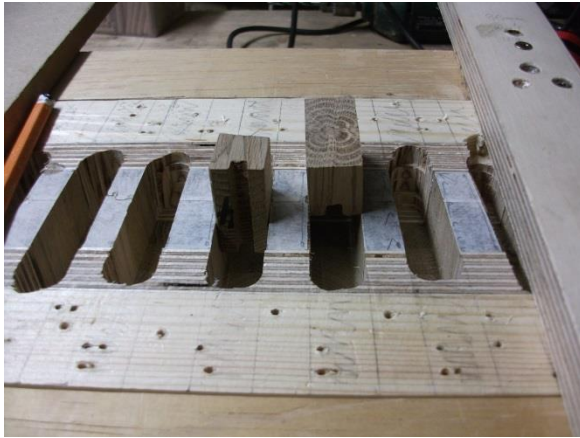


Image 54 Checking lath fit with seat housing



Image 55 Reconfiguring router jig

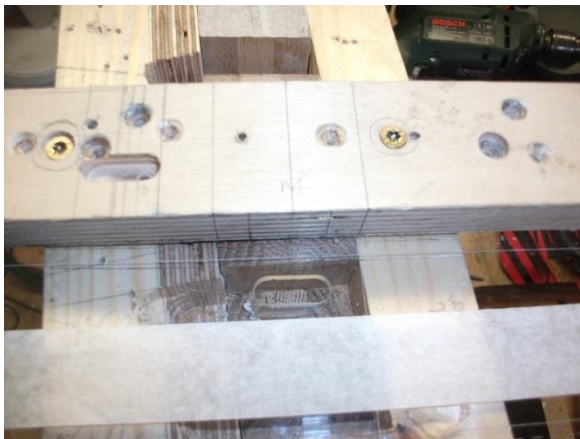


Image 56 reconfigured router template to domino



Image 57 Arm Template



Image 58 Sanding cut out arms to shape



Image 59 Marking out of seat for arm post joint



Image 60 Arm post fitted

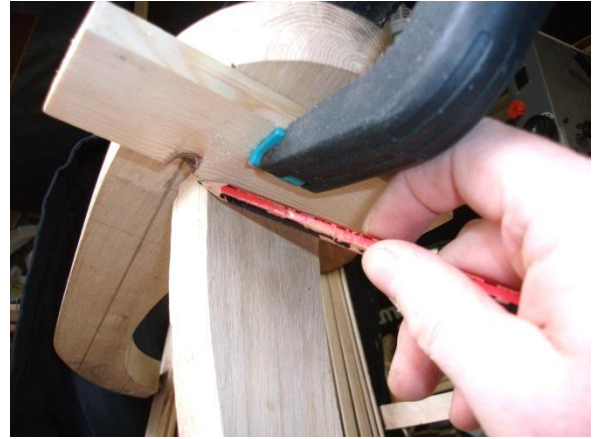


Image 61 scribing angle of arm post joint



Image 62 Position of back legs

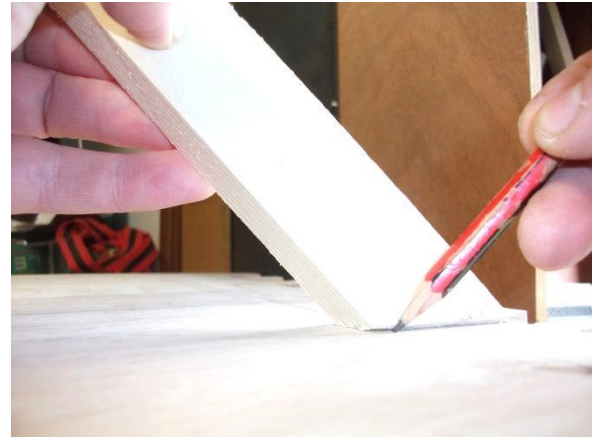


Image 63 Angle and rake of leg



Image 64 Drilling legs for fixing bolt



Image 65 chair dry fitted together



Image 66 Seat positioned on bench face down



Image 67 Laths arranged into sequence



Image 68 Central backrest laths with threaded bar



Image 69 laths fitted and glued to 5 deg. angle



Image 70 Cascamite glue



Image 71 Applying glue to leg mortises



Image 72 Fitting threaded bar through legs and backrest



Image 73 Threaded bar fitted at leg crossing



Image 74 Glue arm posts to seat



Image 75 Remaining lath fed on to threaded bar



Image 76 Cot bolts ready for fitting

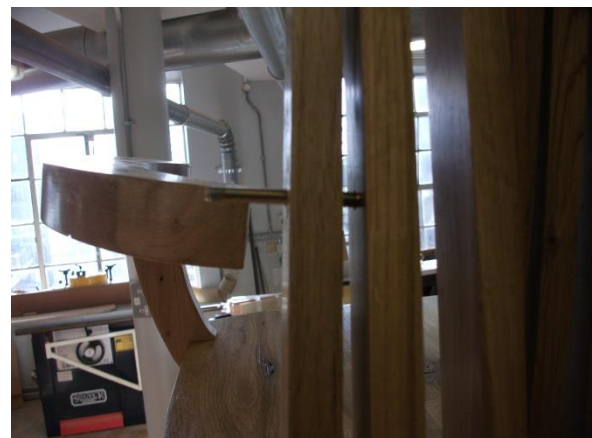


Image 77 Cot bolt fitted through two outer backrest lath before connection to arm



Image 78 Spray glue

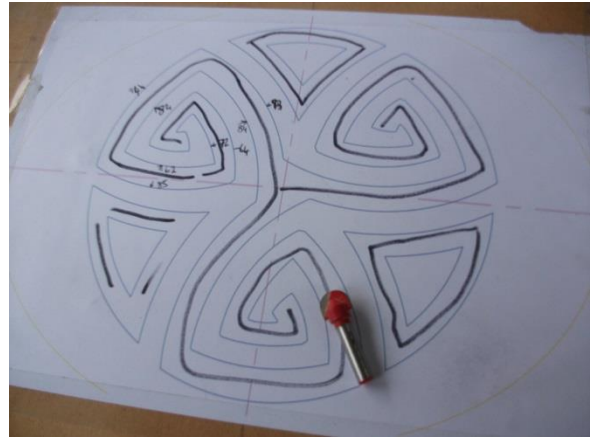


Image 79 Shield design Template fitted to MDF

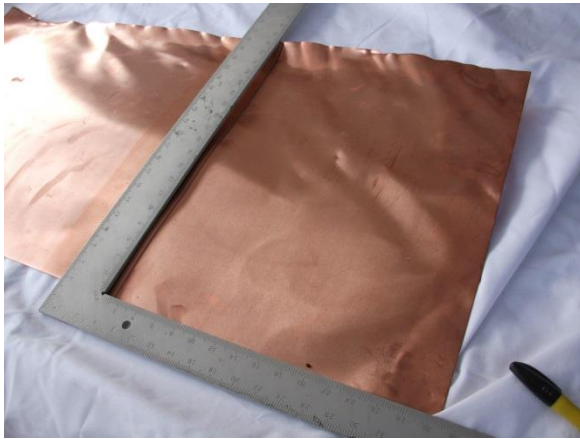


Image 80 copper being sized and marked out



Image 81 Copper being cut to size



Image 82 copper clamped to design former



Image 83 Design being marked out



Image 84 Design being marked out



Image 85 Hammering design into copper with backing former

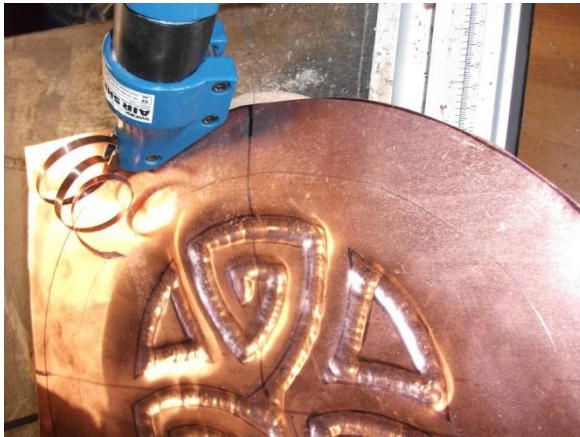


Image 86 Pneumatic nibbler shears



Image 87 seat back support with hole for embossed design housing



Image 88 Clean off marked with methelayted spirits



Image 89 Degrease copper



Image 90 Copper patina bath



Image 91 Copper pins holding edge belt and shield in place