DP Design technology student work

An additional sample of student work

(first assessment 2016)

Design project new sample: HL moderator comments

Introduction

This sample of student work has been developed to further support teachers and students when developing their design project. The sample comprises of 47 pages of A4 and covers the six assessment criteria, A-F, to meet the Higher Level requirements. The total mark is 47 out of 54.

The sample of work has been assessed by first identifying the level of achievement for each strand (highlighted) and then by applying the 'best-fit' approach. The detailed assessment comments indicate how and where the evidence for achievement against each strand is within the design project, and the additional evidence that the student would need to include in order to achieve a higher mark.

For students and teachers studying at SL, please consider only the first four criteria: A-D, where the marks total 33 out of a possible 36.

This sample will be added to the Teacher Support Materials on the Online Curriculum Center (OCC), where there are three existing samples at SL and HL. Following the first examination session in May 2016, further samples of student work from that session will be added to the Teacher Support Material.

Lamp – USB charger

This project involves converging technology in order to maximise the limited space on a study desk.

Assessment

Criterion	A	B	C	D	E	F	Total
Level achieved	8	9	8	8	7	7	47

Criterion A: Analysis of a design opportunity

Maximum: 9

Marks	Level descriptor
0	The work does not reach a standard described by the descriptors above.
1-3	The candidate: • **Identifies** a problem • **States** the key findings from relevant market and user research • Develops a simple brief which identifies **few** relevant parameters of the problem • Develops a marketing specification which **states** the requirements • Develops a design specification which **states** the requirements
4-6	The candidate: • **Identifies** an appropriate problem which leads to a design opportunity • **Describes** the key findings from relevant market and user research • Develops a brief which identifies **some** of the relevant parameters of the problem • Develops a marketing specification which **outlines** the requirements • Develops a design specification which **outlines** the requirements
7-9	The candidate: • **Describes** an appropriate problem which leads to a design opportunity • **Explains** the key findings from relevant market and user research • Develops a **detailed** brief which identifies the relevant parameters of the problem • Develops a marketing specification which **justifies** the requirements • Develops a design specification which **justifies** the requirements

This work achieved level 8 because the candidate:

- Page 1-2 – The candidate identifies a problem for lighting, but evidence is mostly personal. There is evidence of some discussion which is mostly personal and related to their own situation, but further consideration of a market audience should ideally be considered.

- Page 3-5 – Summarises the useful research. The reporting of the research is focused and appropriate to the problem.

- Page 6 – The design brief is detailed. It includes the relevant parameters of the problem and highlights the benefits of the proposed product and considerations for its success.

- Page 7 – The marketing specification addresses each of the suggested elements and justifies the requirements. The target market is identified, two personae are outlined, a major trend in the market is identified, the user need is further explained, and a brief analysis of the competition is included which identifies where the product will sit in the market in relation to the competition.

- Page 8 – Each point in the design specification is fully justified. Each point is specific. The specification is detailed and addresses function, aesthetics, materials, the target market, the environment the product will be used in, sustainability issues, and quality.

The candidate would have achieved a higher level if they had:

- Considered market needs for a detailed discussion of the problem, through use of interviews, questionnaires, newspaper articles, etc.
- Considered the type of products to charge.
- Further justified the marketing specification to consider where the product could be sold.

Criterion B: Conceptual design

Maximum: 9

Criterion B: Conceptual design

Marks	Level descriptor
0	The work does not reach a standard described by the descriptors below.
1-3	The candidate: • Demonstrates **limited** development of **few** ideas which explore solutions to the problem • Selects the most appropriate idea for detailed development **with no justification**
4-6	The candidate: • Develops ideas with reference to the specifications which explore solutions to the problem • Uses concept modelling **with limited analysis** • Selects the most appropriate idea for detailed development **with limited justification**
7-9	The candidate: • Develops **feasible** ideas to meet appropriate specifications which explore solutions to the problem • Uses concept modelling **to guide design development** • **Justifies** the most appropriate idea for detailed development

This work achieved level 9 because the candidate:

- Page 9-10 – Proposed a wide range of alternative ideas, where a mood board is used as inspiration.
- Page 11-19 – Develops four ideas to include function, aesthetics and user needs. The candidate shows incremental development and evidence of ongoing evaluation to guide design thinking. The evaluation establishes the feasibility in relation to the specifications.
- Page 20-22 – Develops the leaf head and base to consider shape and functionality. The candidate makes reference to materials and techniques appropriate to make the product. The candidate uses testing of lamination and simple electronics to aid development. Evaluation is continued.
- Page 23-24 – Considers how the lamp will be assembled and the need for wiring cavities, showing how the wires will run through the parts of the lamp.
- Page 25-26 – Justifies most decisions against specifications.
- Page 9-26 – Uses a variety of relevant concept modelling, with good use of CAD and 3D models to help refine and test for the most feasible solution

The candidate could have further evidenced work in this section, if they had:

- Considered possible assembly of the all components, to include electronics and USB socket.
- Considered how the USB and wiring may to be incorporated in each design.
- Used physical models to compare all four designs further.
- Justified choosing the leaf design before its detailed development.

Criterion C: Development of a detailed design

Maximum: 9

Criterion C: Development of a detailed design

Marks	Level descriptor
0	The work does not reach a standard described by the descriptors below.
1-3	The candidate: • **Lists** some appropriate materials and components for a prototype • **Lists** some appropriate manufacturing techniques for prototype production • Develops a design proposal **that includes few details** • Produces an **incomplete** plan **that contains some production details**
4-6	The candidate: • **Outlines** some appropriate materials and components for a prototype • **Outlines** some appropriate manufacturing techniques for prototype production • Develops a design proposal **that includes most details** • Produces a plan for the manufacture of the prototype
7-9	The candidate: • **Justifies** the choice of appropriate materials and components for a prototype • **Justifies** the choice of appropriate manufacturing techniques for prototype production • Develops an **accurate and detailed** design proposal • Produces a **detailed** plan for the manufacture of the prototype

This work achieved level 8 because the candidate:

- Page 27-30 – Justifies choice of materials and processes based on properties, availability of equipment and wastage. Appropriate testing of techniques evident.
- Page 20 – Presents some evidence of testing techniques for manufacture.
- Page 28 – Summarises decisions for material choice.
- Page 30 – Summarises decisions for processes and standard component choice.
- Page 31-33 – Includes comprehensive engineering drawings and components identified. Most details evident to aid manufacture by the candidate.
- Page 34 – Produces a detailed plan for the manufacture of each major component including health and safety, materials, time indication, techniques and process.

The candidate would have achieved a higher level if they had:

- Included electronic circuit wiring diagrams, PCB layout and components.
- Considered other materials to be used with the same depth as wood considerations.
- Included reference to quality control or quality assurance in the plan for manufacture.

Criterion D: Testing and evaluation

Maximum: 9

Criterion D: Testing and evaluation

Marks	Level descriptor
0	The work does not reach a standard described by the descriptors below.
1-3	The candidate: • Evaluates the success of the solution against **few** aspects of the marketing specification **with no evidence of testing** • Evaluates the success of the solution against **few** aspects of the design specification **with no evidence of testing** • **Lists** how the solution could be improved
4-6	The candidate: • Evaluates the success of the solution against **some** aspects of the marketing specification • Evaluates the success of the solution against **some** aspects of the design specification • **Outlines** how the solution could be improved
7-9	The candidate: • Evaluates the success of the solution against the marketing specification • Evaluates the success of the solution against the design specification • **Explains** how the solution could be improved

This work achieved level 8 because the candidate:

- Page 35-38 – Made use of user testing, feedback and evaluation against specifications to inform decisions.

- Page 39-40 – Makes realistic suggestions to improve the product. Sketches and annotation show where improvements could be made.

The candidate would have achieved a higher level if they had:

- Been more critical in their evaluation of the product from the perspective of other users.

- Been more critical in their evaluation against the marketing spec. The cost of each component should ideally be considered.

- Made use of further user testing, expert appraisal and client feedback.

Criterion E: Commercial production

Maximum: 9

Criterion E: Commercial production

Marks	Level descriptor
0	The work does not reach a standard described by the descriptors below.
1-3	The candidate: • **Lists** appropriate materials and components for commercial production • **Lists** appropriate manufacturing techniques for commercial production • **Lists** design modifications to the solution required for commercial manufacture
4-6	The candidate: • **Outlines** appropriate materials and components for commercial production • **Outlines** appropriate manufacturing techniques for commercial production • **Outlines** design modifications to the solution required for commercial manufacture
7-9	The candidate: • **Justifies** the choice of materials and components appropriate for a commercial product • **Justifies** the choice of manufacturing techniques appropriate for commercial production • **Explains** design modifications to the solution required for commercial manufacture

This work achieved level 7 because the candidate:

- Page 42 – Justified the potential size of the market when justifying injection moulding. Fully considered the shape of the mould and selection of ABS as a suitable material for volume production.

- Page 41-43 – Outlines the nesting of parts, CNC processing and injection moulding for commercial manufacture.

- Page 43 – Outlines the design modifications to the solution required for commercial manufacture considering the assembly of the head and modifications to the stem that allows quick and easy assembly while maintaining aesthetics.

The candidate would have achieved a higher level if they had:

- Fully justified reasoning for CNC manufacture of base/stand as unit size may require a different process which is more efficient.

- Included greater explanation of e.g. the manufacture of the PCB

- Justified the choice of materials, components and manufacturing techniques with regards to cost and supply.

Criterion F: Marketing strategies

Maximum: 9

Criterion F: Marketing strategies

Marks	Level descriptor
0	The work does not reach a standard described by the descriptors below.
1-3	The candidate: • **States** a target sales price • **Lists** some promotional strategies for the solution
4-6	The candidate: • **Identifies** a target sales price • **Identifies** appropriate promotional strategies for the solution
7-9	The candidate: • **Justifies** an appropriate target sales price • **Discusses** appropriate promotional strategies for the solution

This work achieved level 7 because the candidate:

- Page 44 – Justifies the sales price for moulding, other components and profit margin.
- Page 45 – Product family, mass customisation considered to widen market opportunities.
- Page 45 – Target sales are fully justified using the invention calculator. Existing products are compared resulting in a proposed sale price for the final product.
- Page 46-47 – Good promotional strategies are discussed and shown as a potential online marketing promotion. A timeline for a promotional strategy is outlined.

The candidate would have achieved a higher level if they had:

- Linked the promotional strategy to the market.
- Discussed the reasons for the choice of marketing and promotional strategies.
- Considered discussing the sale of the product with a local store.

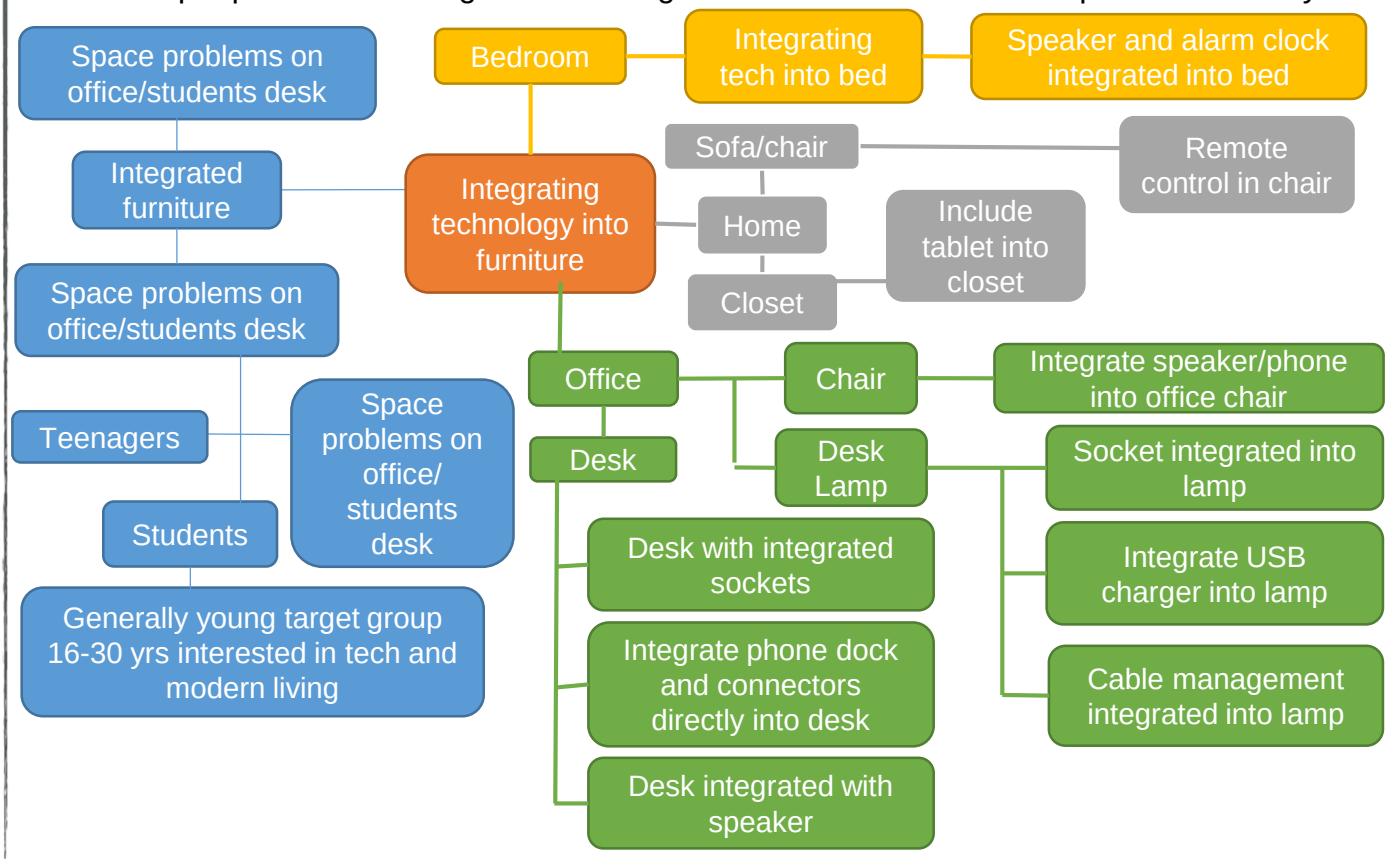
The problem

The space in an average boarding room is usually just enough to fit in a bed, a desk and a cupboard. When the size of the room is relatively big, the size of the desk seldom is, especially if working with many folders and electronic devices. Most students also have a desk lamp that reduces the space of the desk even more and prevents them from creating a good work space. Lack of space is also a problem for people who live in small apartments.

I realised that lack of space is a massive issue in todays society. Today, about half of the world's population lives in urban areas. There are over 400 cities with more than a million people. In developed countries, up to 70% live in larger cities, whereas in poorer countries this rate is below 40%. Given that people are living in smaller spaces whilst wanting to increase their quality of life, it opens up opportunities for a new category of products.

Another observed problem is that dorm rooms often do not have enough power sockets or an internet connection points. Students rely on using modern technology such as phones, tablets or speakers that require a power supply or at least a charging spot. This often takes up space and power sockets in areas that are already very small. Looking at my own desk, one half is covered with charging cables that often reach from one end of the desk to the other due to inconvenient placement of sockets, reducing the working space and adding to clutter.

An idea could be to integrate those technologies into an everyday piece of desk furniture. Integrating a USB hub or a power socket into a piece of desk furniture could make charging more convenient and by doing so save space. Lots of devices are charged using USB; often one socket is used to supply energy to one USB device. Integrating USB into furniture would make it very convenient for people using multiple USB chargers. It also would save space and fewer plugs would be used leading back to the original problem of increasing the space for modern living. There is a great audience for this kind of product when thinking about the amount of people that are using USB to charge their devices and want keep their desks tidy.



An idea could be to integrate those technologies into an everyday piece of desk furniture. Integrating a USB hub or a power socket into a piece of desk furniture could make charging more convenient and by doing so save space. Lots of devices are charged using USB; often one socket is used to supply energy to one USB device. Integrating USB into a piece of furniture would make it very convenient for people using multiple USB chargers. It also would save space and fewer plugs would be used leading back to the original problem of increasing the space for modern living. There is a great audience for this kind of product when thinking about the amount of people that are using USB to charge their devices and want keep their desks tidy.

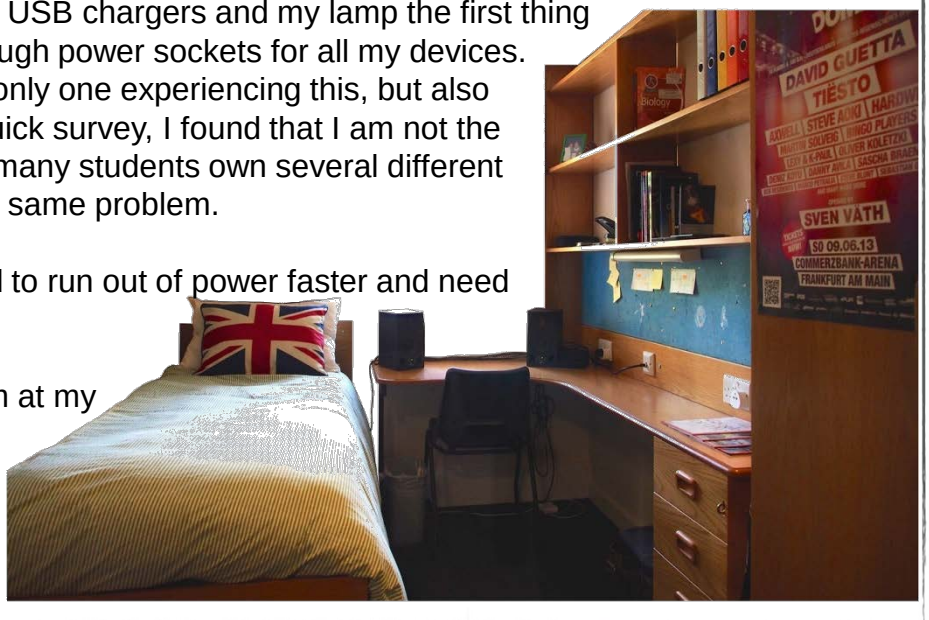
The products in this diagram integrate technology into normal furniture. Many of the products reduce the space used. However many of the existing products share the characteristic that they are entire room solutions rather than stand alone products. That is helpful when initially equipping a room, however in the case of an office or student room which most likely is already equipped stand alone products are much more helpful.

Evidence: I have experienced this problem myself for the last year since I moved to my new boarding school. The space I am living in is very small. Especially because it is a single room the furniture fills the room and makes it seem cluttered.

After plugging in all my different USB chargers and my lamp the first thing I realised that there are not enough power sockets for all my devices. This is a problem. I am not the only one experiencing this, but also many fellow students. After a quick survey, I found that I am not the only one experiencing this, but many students own several different electronic devices and have the same problem.

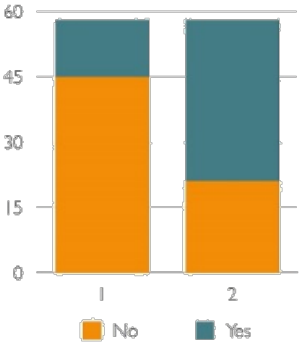
Furthermore those devices tend to run out of power faster and need charging more often.

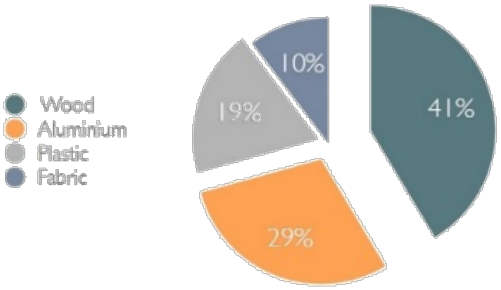
The picture shows a dorm room at my college. The space is clearly limited and the desk, despite being very tidy, still lacks sufficient working space.



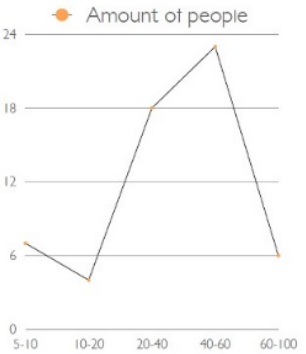
Key findings

I surveyed 58 people. 13 were actually looking for a new desk lamp (1) despite that 21 were not happy with their current desk lamp (2). This suggests that a desk lamp is not something that one usually buys regularly and that the market is not changing and there is little or no innovation in the segment.

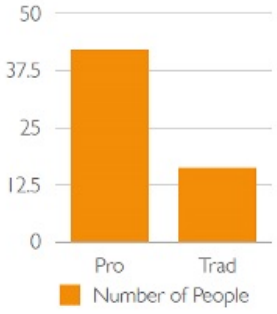




41% prefer wood, followed by aluminium with 29%. I expected Aluminum to score high since many designer lamps are made out of it, so this shows that the market might not actually satisfy the consumers needs.



Most people would spend between £20 and 60 on a new desk lamp. Few would spend more than £60. There is a clear limit on how much the product can retail for. I should aim for the material cost to be about 1/3 of the retail cost – approximately £20.



Consumers prefer progressive design. This means that consumers are generally very open minded about new and innovative products even in an area which is dominated by traditional design.

Image of lamp removed due to copyright	Image of lamp removed due to copyright	Image of lamp removed due to copyright	Image of lamp removed due to copyright

From analysing existing desk lamps they do not differ much from each other, which shows potential for a gap in the market.

The price ranges from £15-55 with the main difference primarily materials and design. Most feature moveable lamp heads providing light at any angle. However, the more expensive and aesthetically pleasing, the less likely these features are included.
Few are technologically advanced. Some let the user control brightness with an intuitive touch panel allowing greater flexibility. The main problem with these lamps is that they often look cheap and ugly. Also, often they do not have an established brand or clear brand strategy,.
Existing lamps tend to be made out of plastic, aluminium or steel. The quality of the material is often balanced by the overall design. For my design I will try to increase the quality by chosen good materials and a distinctive design

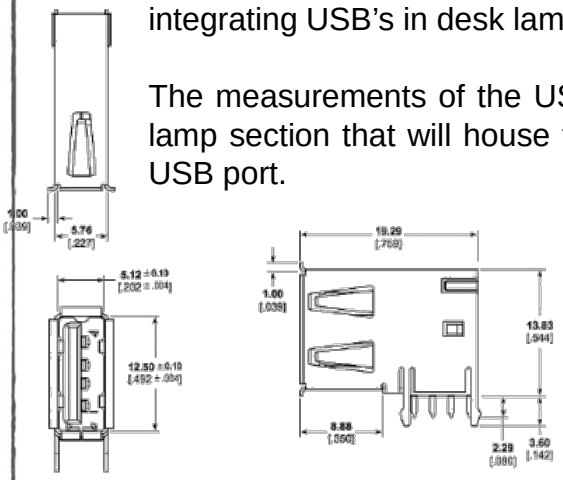
I have identified aspects of their design which I think might be helpful for my investigation:

1. It is clear that an aesthetically pleasing design is important, but one which doesn't limit the functionality of the product.
2. Dual functionality is a major market gap e.g. converging technologies.
3. Environment specific designing.
4. The combination of electronically advanced products and a simple, sophisticated design

All of these aspects will be taken into consideration during the design stage of my product.

Integrating USB sockets in a desk lamp will let the user charge devices and organise cables on the desk, making the desk tidier. Since more devices will charge via USB, integrating USB's in desk lamps could be a pioneering design concept in the future.

The measurements of the USB hub provides important constraints for the size of the lamp section that will house them. I will have to consider a space of 20x14x6mm per USB port.



I examined three types of light source:

- Flourescent bulbs;
- Incandescent bulbs;
- Light emitting diodes (LEDs)

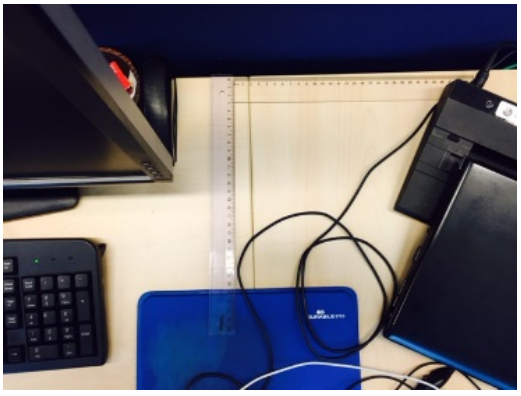
LED is the type of lighting which will be most suitable for my project. The main advantages of using LEDs are:

- Compact and more versatile allowing flexibility in design
- does not heat up significantly
- Can be used to create bright white light and coloured mood lighting, and can be dimmed.
- Low power usage (LED: 6-8 Watt for 800 lumen; Compact fluorescent: 13-15 Watt; Incadescent bulb: 60Watt) costing little to run
- Longest life span at 50,000 hrs

Health and Safety
EC and BSI regulations won't affect my product as a single LED's carry forward voltage is only around 3.3 V.

I also looked at possibility for electric shock. These normally require around 12 to 24 V, I must stay below this level.

Incandescent Bulbs heat up very fast and emit 85 btu's/hour compared to 3.4 btu's/hour for a standard light bulb, Compact Fluorescents are not small enough to be suitable for a space efficient desk lamp.



I investigated the space available on my own desk. This is a standard desk used by all students in my college.

The diagram on the left shows how my cluttered desk space – there is not much room. The best position for a desk lamp would be in the space above the mouse mat. This open space measures 19cm x 19cm.

The envelope of the lamp needs to fit in this space.

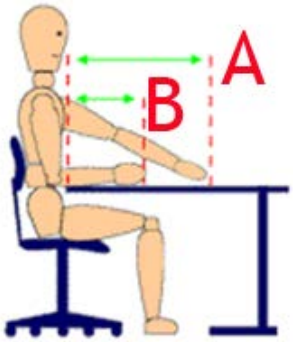
The Philips Hue combines design, a strong brand image and technological innovation. They put the functionality in the foreground whilst maintaining a solid and minimalist but nevertheless profound design.

They use LEDs and can change their colour according to the preference of the consumer. This allows the light to create a certain mood. This inspires me to create a functional product which helps to organise one's desk but that also helps to create a certain mood or atmosphere in an uncomplicated way.

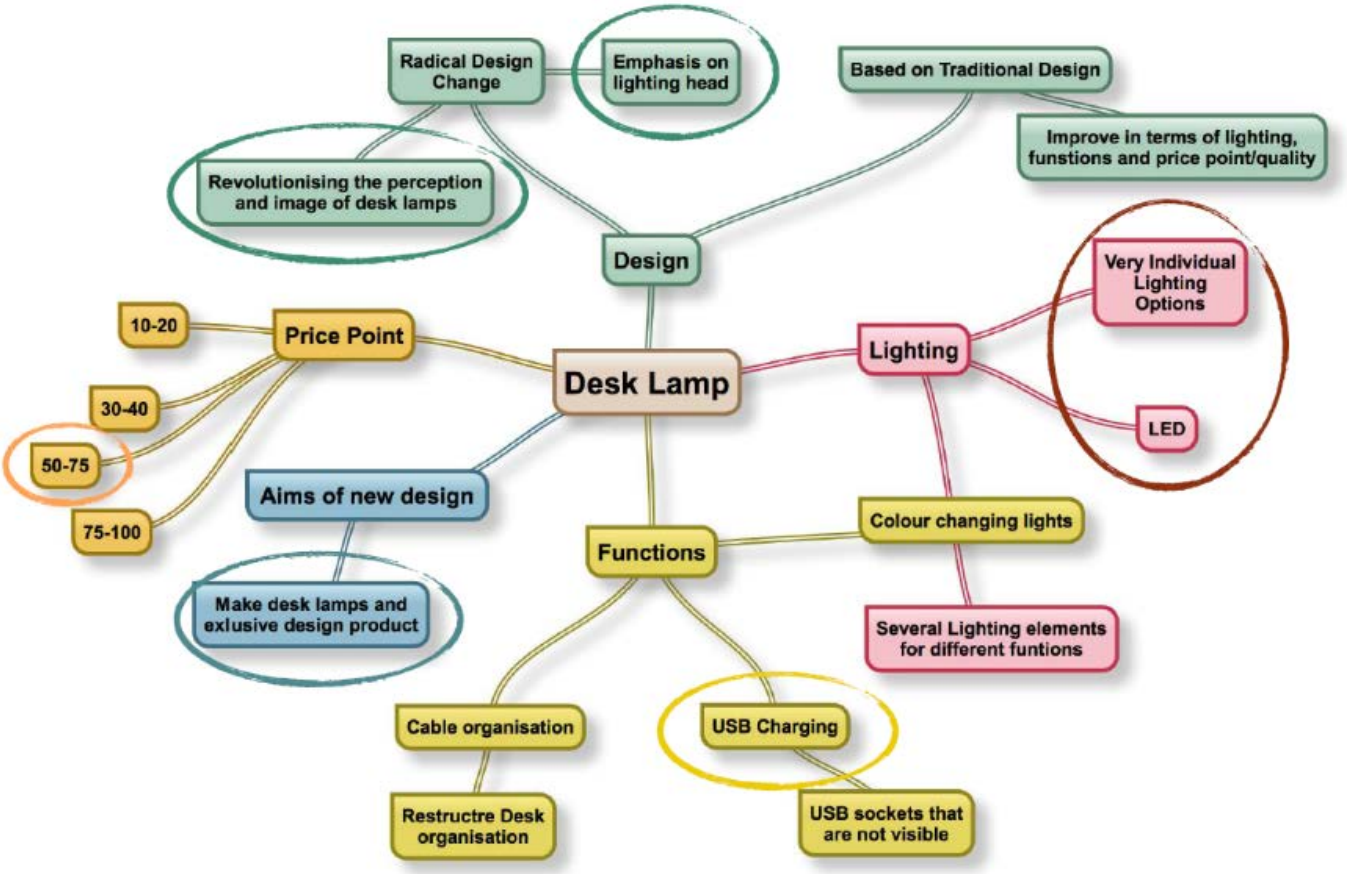
These photos were taken in my room at school.

From gathering anthropometric data and consulting various books, the average width (men and women) of an index finger is 18mm. This is an important figure because the user needs to be able to operate the lamp effectively with ideally one finger. This provides information for how to interact with the lamp switch.

Also, I have collected some data about the work space. The lamp will need to be positioned within the maximum reach are (max working limit), which aligns with the positioning of the desk space. This will have to be planned to be between a minimum of 40cm away from the user and a maximum of 55.5cm.



Anthropometric data for British adults 19-65 years (cm)			
Dimension	5th %tile	50th %tile	95th %tile
Shoulder-grip length (max working limit)	61	66.5	73.5
	55.5	60	71.5
Elbow-fingertip length (normal working limit)	44	47.5	51
	40	43	46



Design brief

Target Group:
15-35 year olds with an interest in technology and modern living/design

Design Goal:
Design a desk lamp that integrates USB ports/power sockets to increase desk space and usability. To converge two functions in to one design.

To create a successful desk lamp for modern living it has to have a major increase in either functionality, design or price. The lamp will therefore focus on integrating power sockets to increase its functionality. It will be aimed at consumers between the age of 15-35 years who live in small spaces and favour a modern lifestyle. With a specific focus on the problem of small spaces being used up by chargers and electronic devices.

The product will be made to attract people interested in technology combined with modern living facing the problem of living in a very small space. This means that students are one of the main target groups. Especially those at a boarding school or university who often live in dorms, hence, they have to deal with extremely small spaces and very little comfort.

The design goal is to increase the quality of life for the consumer by designing a piece of furniture suitable for modern living with integrated everyday electronics such as USB chargers or sockets.

Due to the fact that there is already a very competitive market for modern desk lamps, it is crucial to lay the main focus on the combination between electronics and furniture. This may win many customers and create a new product category.

As the target audience is young the price should not exceed a certain point. On the other hand I aim to design a lamp that will be an exclusive product and not a necessity. The students this will be designed for have a distinguished taste and favour modern design and technology. The research has identified they are willing to pay a higher price around £60.

The lamp will have to be innovative, it is essential that the technological aspect and the combination of two different aspects is at the centre of the product.

At the same time, the desk lamp will have to be designed to provide a product life of between 5 to 10 years. A feature like a USB charging that one part of the product would be preferred to a phone dock, as the USB technology will not change as quickly and is a standard component.

I will create a desk lamp that has the capability to increase the comfort at a working space whilst also decreasing chaos and space used. This will be achieved by including different electronic components in the lamp for example magnets or USBs.

Marketing specification

Target market
The target market is students and young professionals aged between 15 and 35 who live in small flats, shared or boarding accommodation and have limited space. The target market will be tech-savvy and own multiple electronic devices that they use on an everyday basis.

Target audience
There are two main customers that will buy this product.

Personae A	Personae B
Student aged between 15 and 22	Young professional aged between 21 and 35
Spends considerable time working at their desk	Works full-time
Small room – typical student accommodation	Lives in a small flat/apartment renting or owning
Owns many devices charged using a USB connector	
Fashion is important to them	
Limited budgets, but will pay a premium for a good quality, fashionable item	Some disposable income – will pay a premium for a good quality fashionable item

Also, the product must be appealing to people who may buy this as a gift.

Market analysis
In 2013, the LED lighting market was estimated to be worth £330 million. The LED lighting market is expected to continue to grow due to LEDs being preferred to replace and upgrade existing lighting. This market includes all LED lighting products and not just domestic desk lamps. LED lighting is preferred due to the energy cost savings and reduces CO2 emissions in creating that energy.

User need
The users need a desk lamp that is easy to use, can provide multiple lighting functions – for work and to set a mood, can charge more than one USB device, reduces the number of cables going across a desk, is convenient to use, helps the desk to remain uncluttered and messy, is a progressive and modern design.

Competition
The market for desk lamps is quite competitive, however, I have identified a gap in the market for a lamp that integrates USB charging points. I have had difficulty finding any similar products on the market that combines these two functions. Many lamps are powered by a USB port i.e. you can plug it into your laptop to operate it, but there are very few that integrate a USB charging/power point. The ones that I have found retail at around $100 (Satechi Smart LED desk lamp) to $249 (Conof USB desk lamp).

There are many desk lamps available and many products designed for charging devices using a USB port. However, these two products, as far as I can see, have not been integrated into a convergent product at an agreeable price.

I will design my lamp to be aimed towards the £60 target price.

Design specification

Function

1.1 The source should provide at least 500-1000 lux when it is dark to allow performance of visual tasks of medium contrast or small size such as reading.
1.2 Low power, low profile LEDs ~12V OC. that can change their colour should be used to enable the user to create a different ambience in the room to suit their mood by changing the colour of the light.
1.3 It has to be aesthetically pleasing and innovative. The styling should be inspired by existing products, nature or architecture as such shapes will be familiar to the user group.
1.4 The product should be multifunctional to help organise/improve an office space e.g. USB charging. There is limited desk space available so efficient use of space and incorporation of features would be an advantage over competitor products.
1.5 The product should have a base size less than 190mm^2 based on the size of available space on my desk. Research indicates when considering all other products used on a desk there is limited space for the product. Its height should be less than 400mm to increase stability.
1.6 The product should weigh less than 2kg to aid portability and reduce distribution costs.
1.7 The product should retail for £60, manufacture should cost less than £20 as this is considered a price my market is willing to pay.
1.8 It should be powered from 240v mains, using a transformer to power the light source.

Aesthetics and materials

2.1 The product has to be made within the constraints of the school workshop. I have access to CNC machinery and 3d printing as well as more traditional manufacturing techniques. The prototype should be able to manufactured in less than 10 hours.
2.2 The Design and Materials should be chosen in regard to function and not independently. The materials used should be good electrical insulators to protect the user. The materials used need to be able to be finished to give a smooth surface and edges as this will also make the product safer to use.
2.3 The materials have to depict high quality to enable a higher retail value.
2.4 The material and market research shows that one material used should be a high quality finish hard wood.
2.5 A surface finish should protect the product from everyday use. This will allow easy cleaning and reduce any damage through spillage of liquids.

Target market

3.1 The product should appeal directly to the target market and retail at less than £60.
3.2 The market gap which was outlined during the planning and research stage should be filled
3.3 Preferences expressed by potential consumers should be taken into account. Some form of mass customisation should be considered to fit in with needs of individual clients.

Environmental

4.1 The product should be designed in context of the environment that it could be placed in
4.2 It should be compatible with other products that the target market might have on their desk
4.3 The size of the product has to be appropriate for different desk sizes

Sustainability

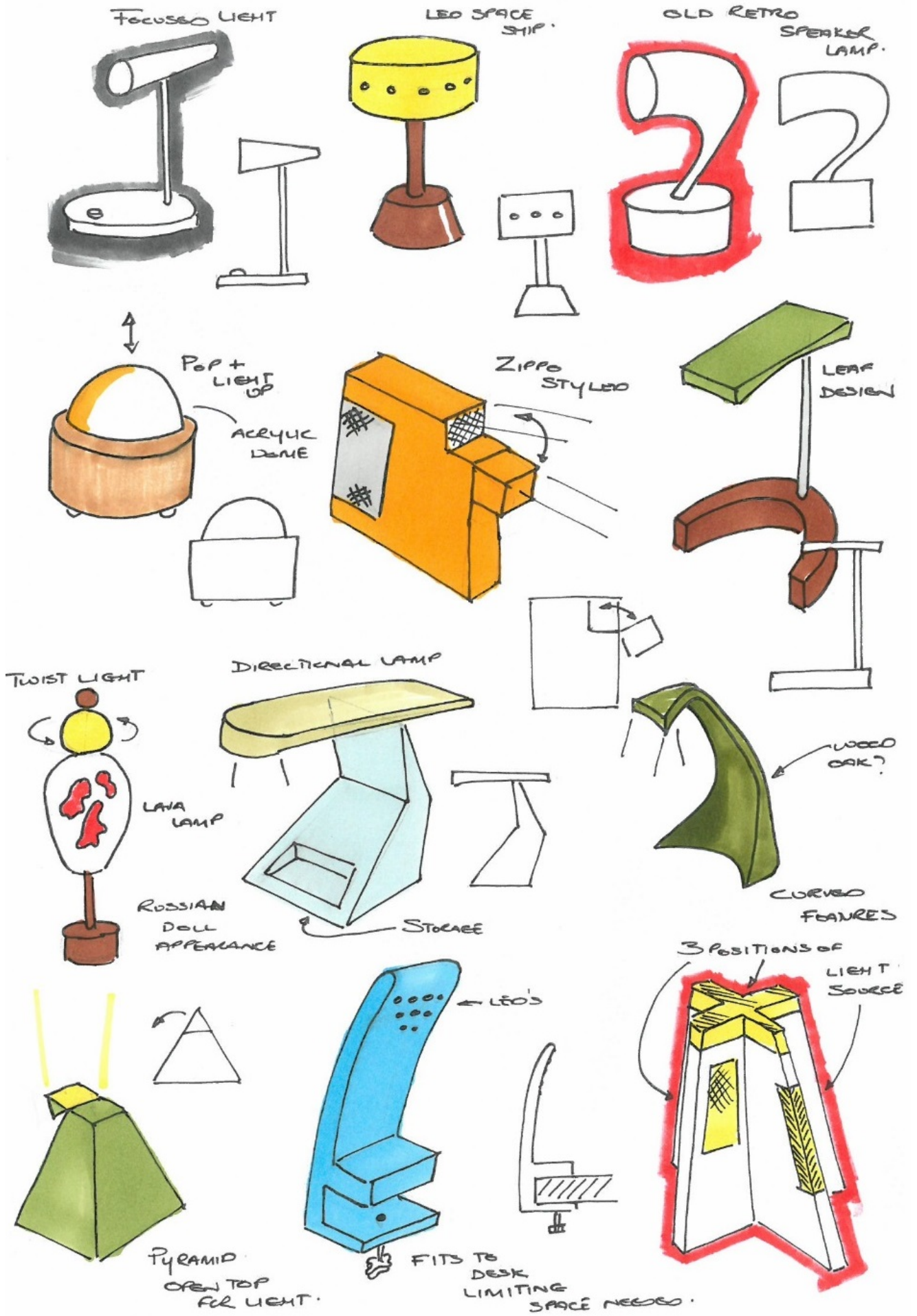
5.1 Recyclability of the product should be taken into account
5.2 The materials should be eco-friendly in some manner
5.3 The product should conform with all the European regulations identified in the research

Quality

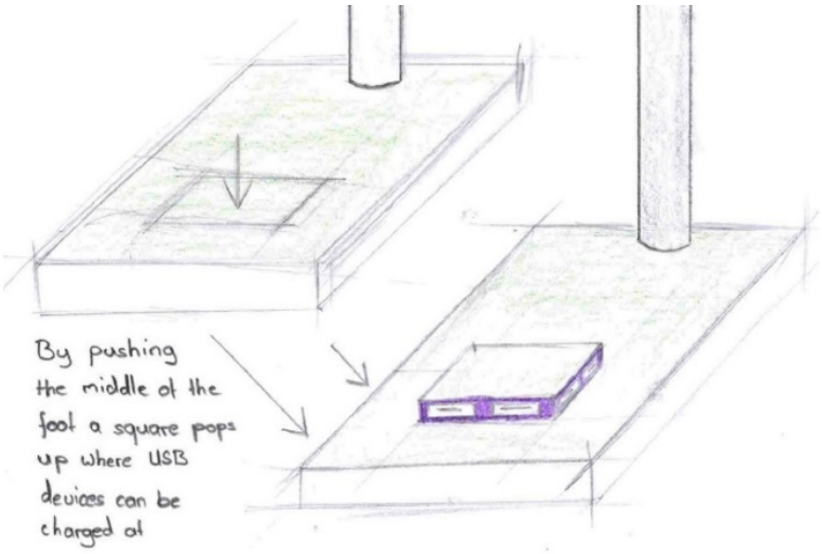
6.1 The quality of the product should be maintained throughout the manufacturing process. (Checking against Specification)
6.2 The appearance of the product should be of high quality
6.3 The materials used in the process should be of high quality
6.4 The design of the product should be original and innovative.

Mood Board and Inspiration

Initial Ideas and concepts

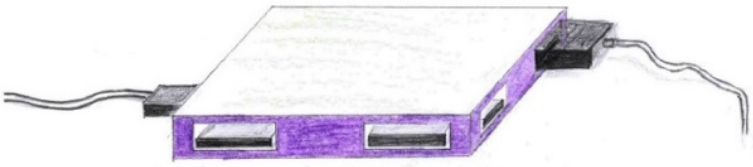


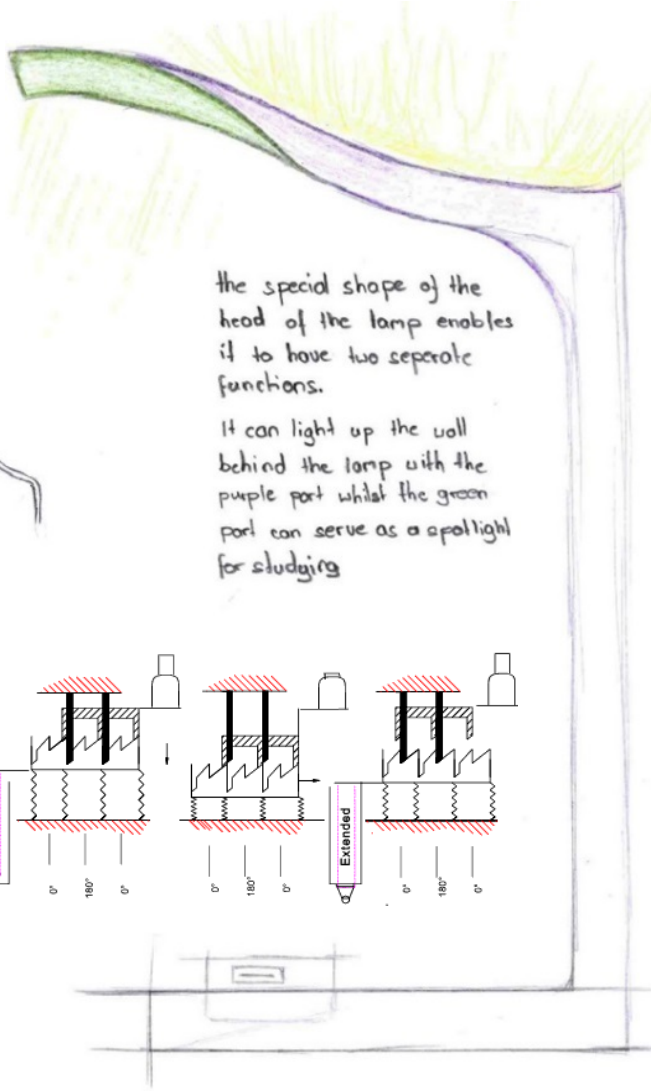
Development of ideas – the leaf design

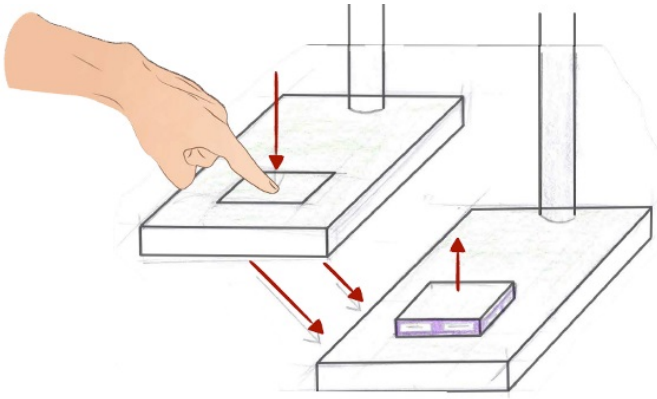


The pictures show that I imagined the USB port to be included in the base of the design. I considered placing the USB port on the back of the product so it does not disturb the design, but it would be very inconvenient and not very intuitive for the consumer if the USB port was placed here. This would mean that the user would have to reach around the product to plug in a device or USB stick potentially scratching the surface on the back.

This would also make the design inconvenient and defy the purpose of creating a smart workspace. It therefore was necessary to create a design that incorporates a USB port in the front but without it being clearly visible

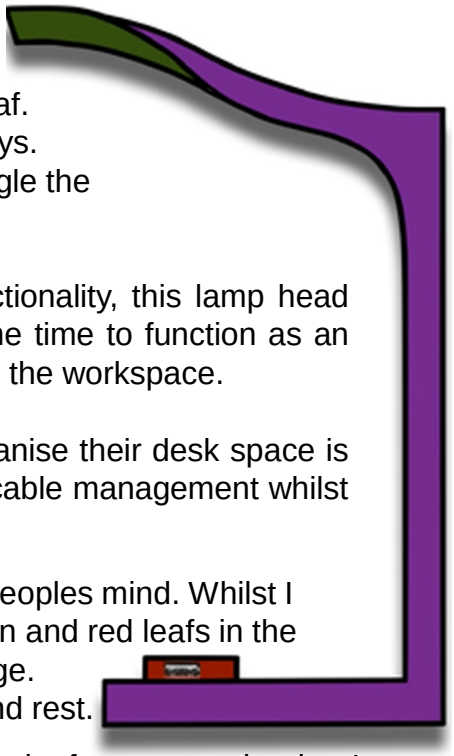






The drawing on the left hand side shows what I imagined to be the best way of managing the problem. The USB ports would be attached to a pat of the based that can move up just enough to expose the USB ports.. This would be achieved by gently pushing down on this part of the surface. This design idea was adapted from the design of ball-pens where this system is used to expose the actual pen.

This design was inspired by the shape of a leaf. Leafs are a natural building block of life as they photosynthesise. I was inspired to design the lamp head based on the shape of the leaf. The curves of the leaf make it reflect light in many different ways. This gives it a very different appearance, depending on the angle the leafs are shined upon the entire lamp will look different.



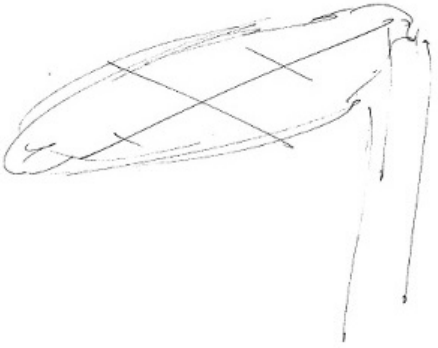
One insight from the research was that to feature multi functionality, this lamp head can be used to serve as a normal office lamp but at the same time to function as an ambient light which can create a mood by colouring the light in the workspace.

Also, the capability of the design to help the consumer to organise their desk space is important. By including the USB socket, the lamp could help cable management whilst not obviously showing that it does.

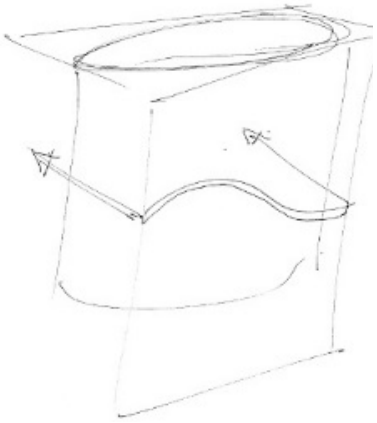
Leaf have the capability to create different types of moods in peoples mind. Whilst I associate green leaves with spring, life and growth, I see brown and red leafs in the autumn as a sign of the upcoming winter and a sense of change.
I also associate these kinds of leafs with a sense of comfort and rest.

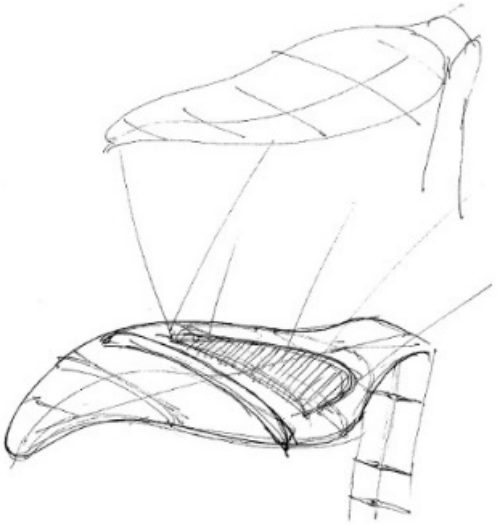
This change of mood according to a change in the colour of the leafs was exactly what I wanted to create with my leaf design. My idea was to create a lamp that has the ability to adapt to the mood of the consumer. So one of the most essential things for me was that the light would have to be able to change its colour and appearance. My aim was to integrate some kind of ambient light into the lamp to enable the customer house the lamp as an **individual** product suiting exactly his needs.

For the design I imagined an S-Shape. This curved shape would on the one hand resemble the idea of the lamp which the design is based on but it would also enable me to integrate two different lighting elements. I did not only want to create a lamp that would work as an ambient light and wood correspond to the mood of the consumer but I also wanted to create a design which was practical and functional. To do so I wanted to integrate a lighting element that would create a bright direct light which could be used for working.



+/- The base of the item will need to be in excess of 190mm to ensure stability. Nature inspired. Less than 400mm in height. Design should be able to be made for less than £20. USB charging adds another feature. Most of the product can be made of hardwood. Encasing electronics could prove difficult.

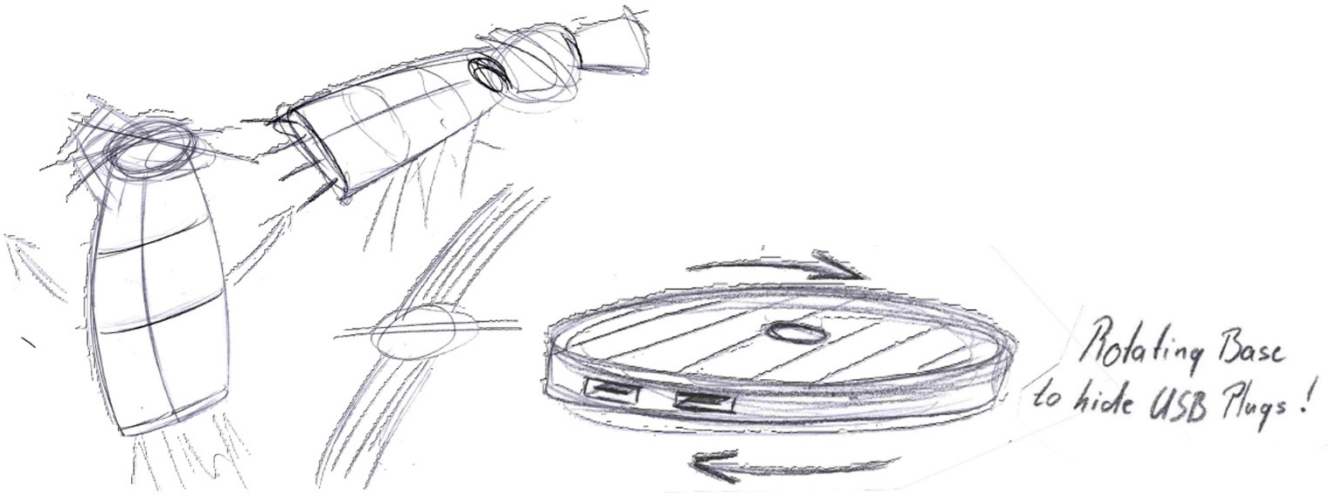


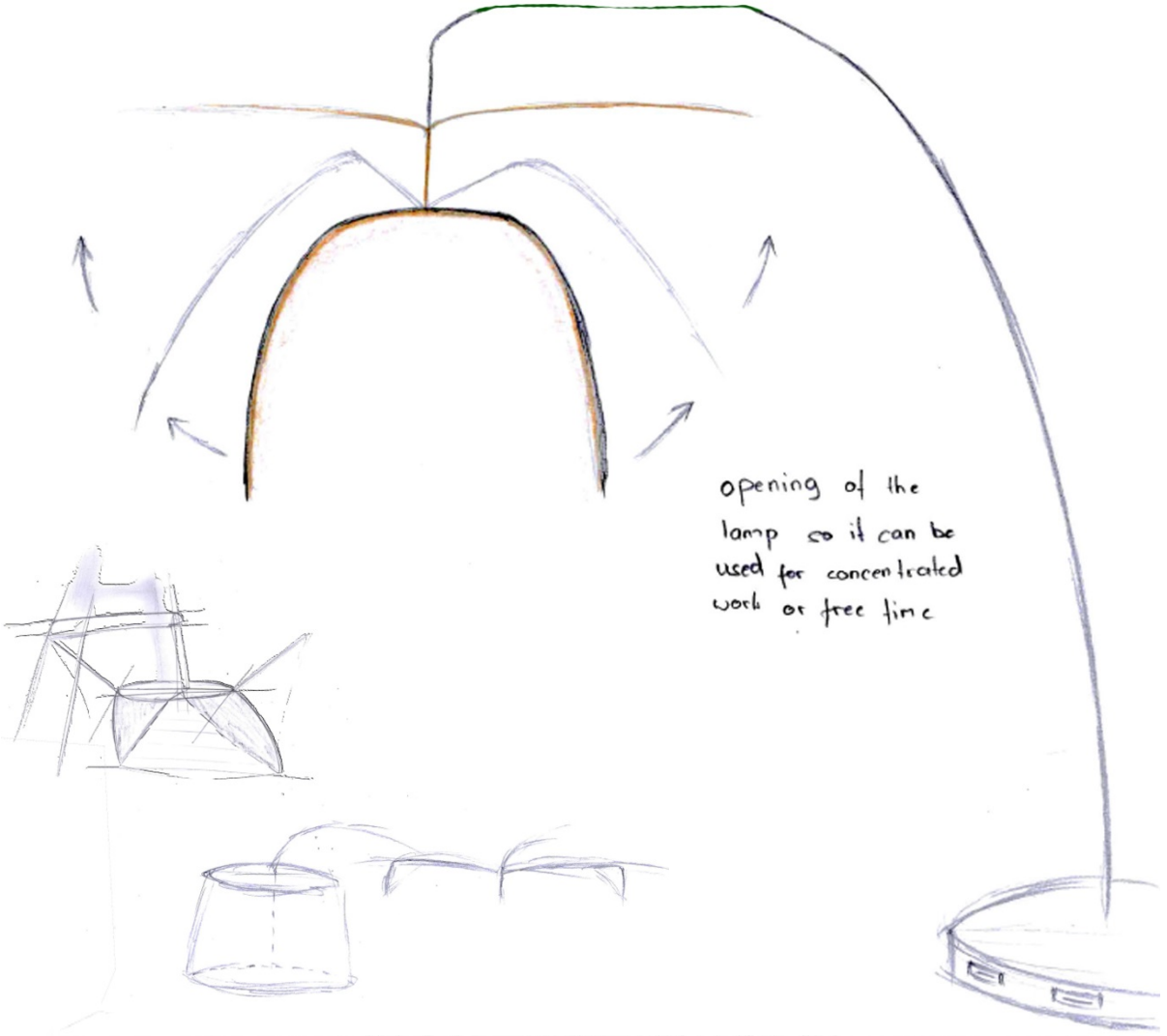


Development of ideas – the satelight design

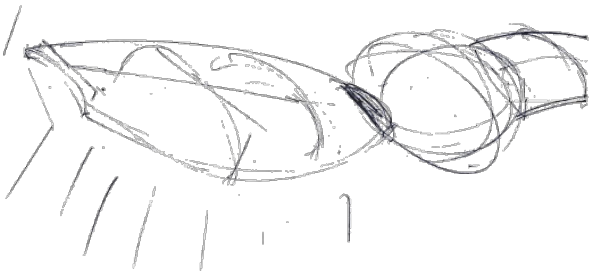
This Initial design was inspired by the shape of a satellite, an item associated with technological progress and by doing so I wanted to reflect the highly advanced technological features as well as the modern and innovative aspects of my design.

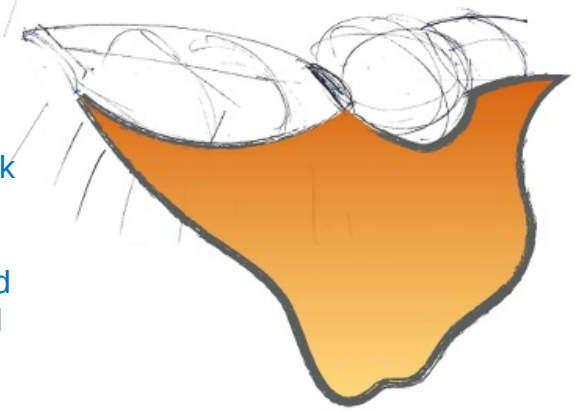
The Design would feature a centre piece which would hold the lighting element or elements. This is also comparable to the design of a satellite as it holds its crucial part such as the processors, fuel and batteries in the “inside satellite”. The long blue panels serve as solar panels in the case of a satellite. In the case of my design idea these two parts would be adjustable to allow them to lead the light in specific directions and to either create an ambient light or more focused working light





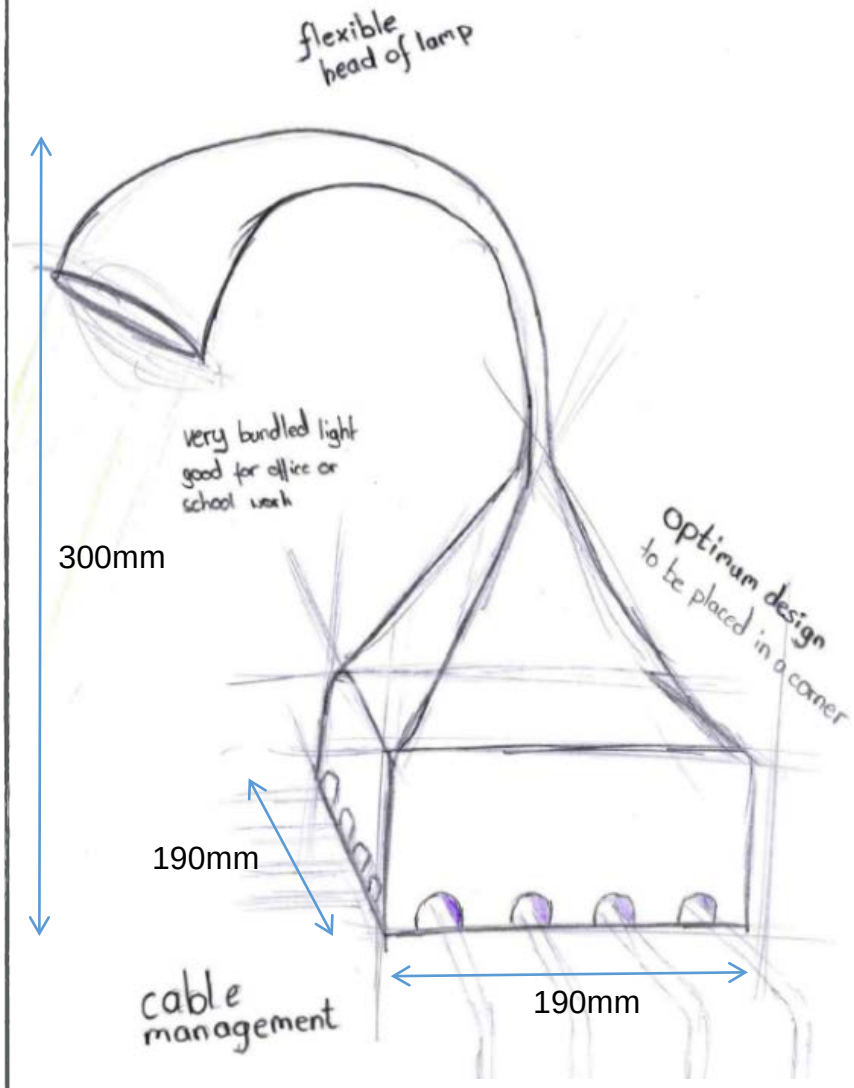
These further drawings of the “Satelight” design highlight how the atmosphere in a room can be changed when changing the head of the lamp. The idea was to create a light that on the one hand combines advanced technology such as USB charging with versatile lighting capabilities. The drawings show how the light can serve as a spotlight for work when the lamp head is closed and as an ambient light when the lamp head is opened. The green area is representing the spotlight. The light is bundled by the enclosed shape of the lamp head. However when the two pieces of the head are torn apart the light is no longer restricted by the lamp head but can now light a wider area. This “ambient light” feature is represented by the orange are in the drawings. The arrows are representing the movement of the different parts of the light head.

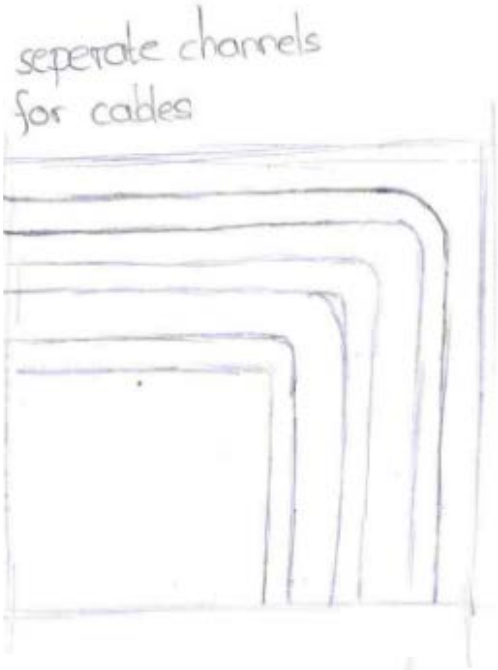


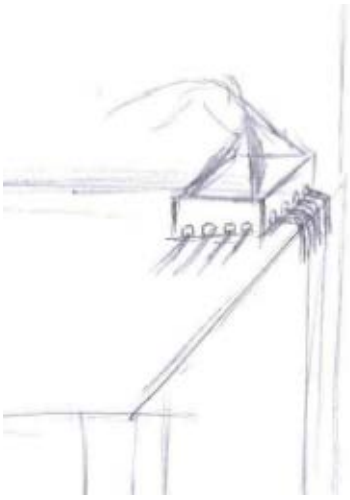


+/- Interesting design inspired by space. Modern sleek design. Footprint can be less than 190x190mm as shade overhangs this. Adjustable direction adds versatility. Wooden base for high end appearance and sustainability. Upright can be polished metal tube and incorporate cables. Lightweight design. Incorporates USB charging.

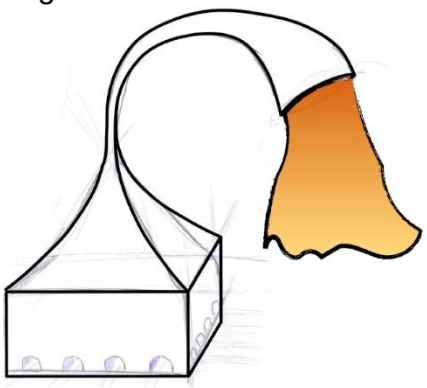
Development of ideas – the gramophone design







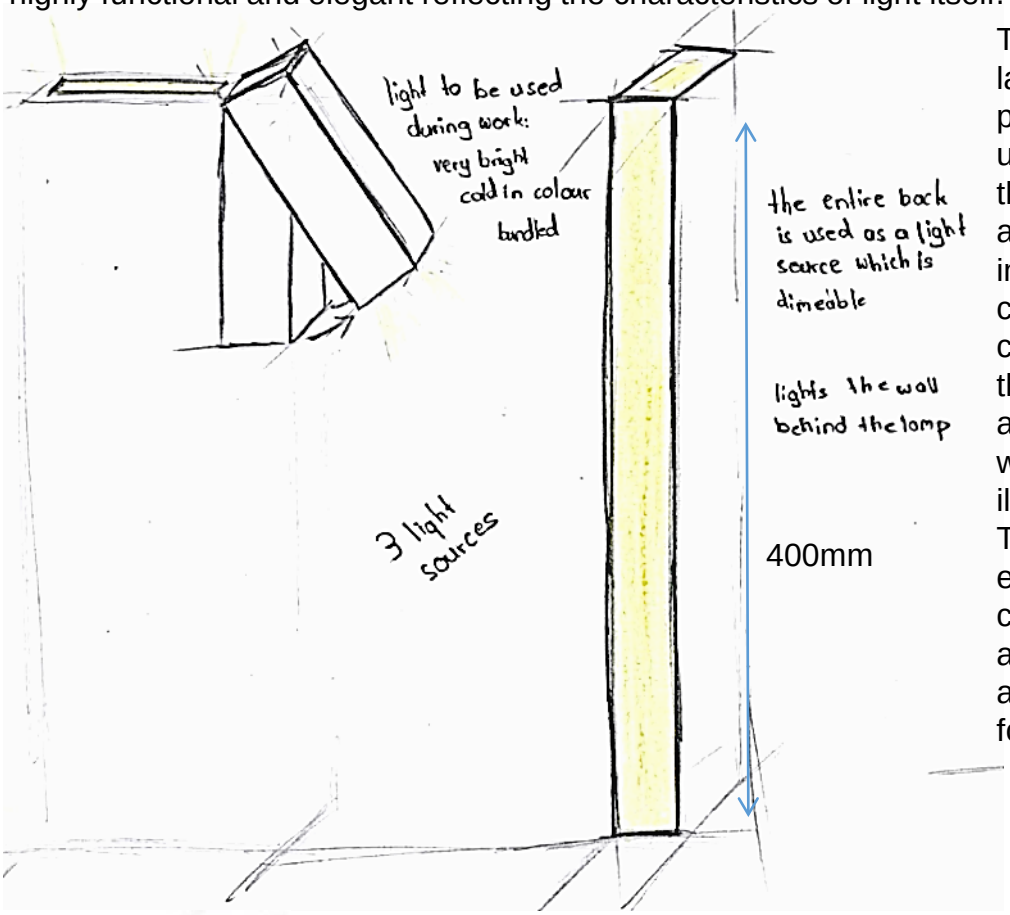
This Initial design was inspired by the design of a gramophone. I was always fascinated by the design of gramophones and this fascination led me to think about the functionality of the design. The gramophone's shape was designed to distribute sound in a room but its function was to amplify sound. This design idea is based on the idea of designing a lamp, not necessarily a desk lamp that resembles the classic design of a gramophone, but would be similar in its functions. The design of the lamp should enable it to distribute the light in the entire room and could be aimed at a specific point and it could also help due to its funnel like design to increase the effect a light source has by amplifying it.



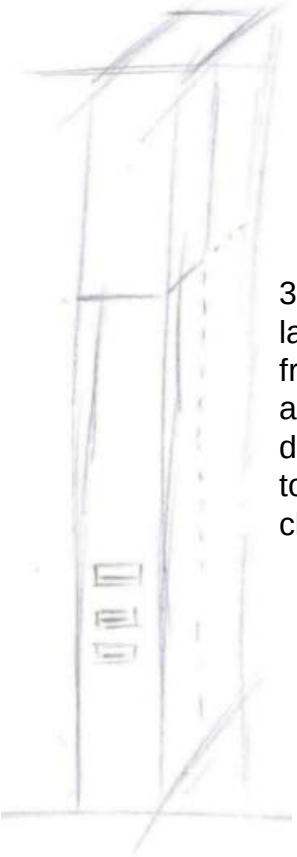
+/- Retro styled design, good use of base design to allow adjustable cable management. Goose neck feature in design will allow greater flexibility. Box like design of base could be heavy. Brass finish of speaker inspired lamp housing could be extremely difficult to make in school workshop. Material costs could be in excess of £20. Heavy base will provide stability.

Development of ideas – the light design

The idea of the “Light” was to reduce a desk lamp to what it is all about: Light. Many existing ideas, the focus of desk lamps is often on aesthetics rather than function. A lamp should primarily focus on its function and versatility. Light is something crucial but nevertheless not graspable, hence a minimalistic design. The design is perceived as a block but also is actually highly functional and elegant reflecting the characteristics of light itself.

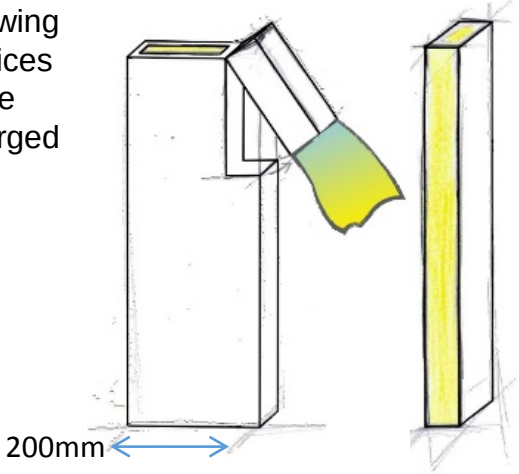


The entire back of the lamp is one big LED panel. This panel would usually face the wall that the desk is placed against allowing the user to indirectly light the desk or create a relaxing colour-changing ambient light that is dimmable. The top also features an LED strip which would allow further illumination of a room. There is also a pull out element which would create a direct lighting and would act as an adjustable spot light ideal for work.



3 USB lamps at front allowing devices to be charged

Not only is one of the main aspects of the design to focus on functionalty rather than aesthetics it is actually raises the question what an aesthetically pleasing lamp should look like. Whilst one could discuss that extensively it could be considered the case that a lamp is aesthetically most pleasing when it is invisible. It is a product that defines its existence through its functionality rather than its appearance. This approach would take away the superficiality in lamp design and would allow the designer to focus on what really matters.

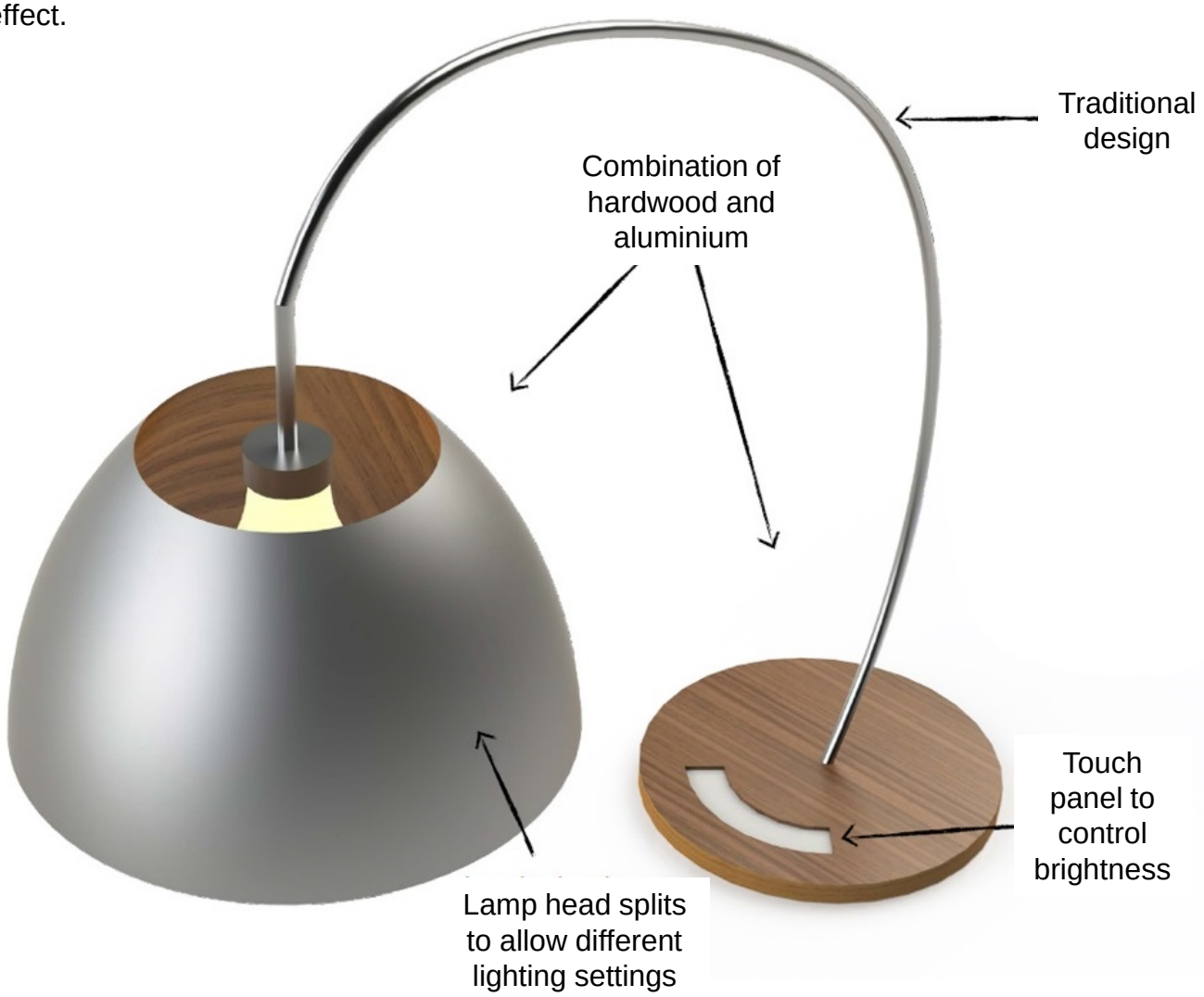


+/- The use of LED technology will make the product more energy efficient and allow the user to use mood lighting. The heavy weight base will create stability, but it will be larger than 190mm in depth. Height will be less than 400mm. The outer case could be made from Oak and finished with Danish oil. It is likely to weigh in excess of 2kg.

Based on the specification, I decided to develop The “Light”, the “Satelight” and the “Leaf” design.

Design development and modelling

At the heart of the satelight, is the idea of change and development. The design is traditional with modern aspects. The lamp is controlled from a touch panel on the lamp base. Based on the primary research a combination of aluminium and hardwood were combined to great effect.



Based on the CAD design I realised that it would be really difficult to create a mechanism for the lamp head which would allow it to change its lighting capabilities. The research that would be required for this could lead to an appropriate outcome, but I could also find that it would be unfeasible. It is questionable whether the added capability that would be achieved by the multi functionality of the lamp would justify the time to research that would be required. The question is also whether this extended feature would really be useful in an everyday situation.

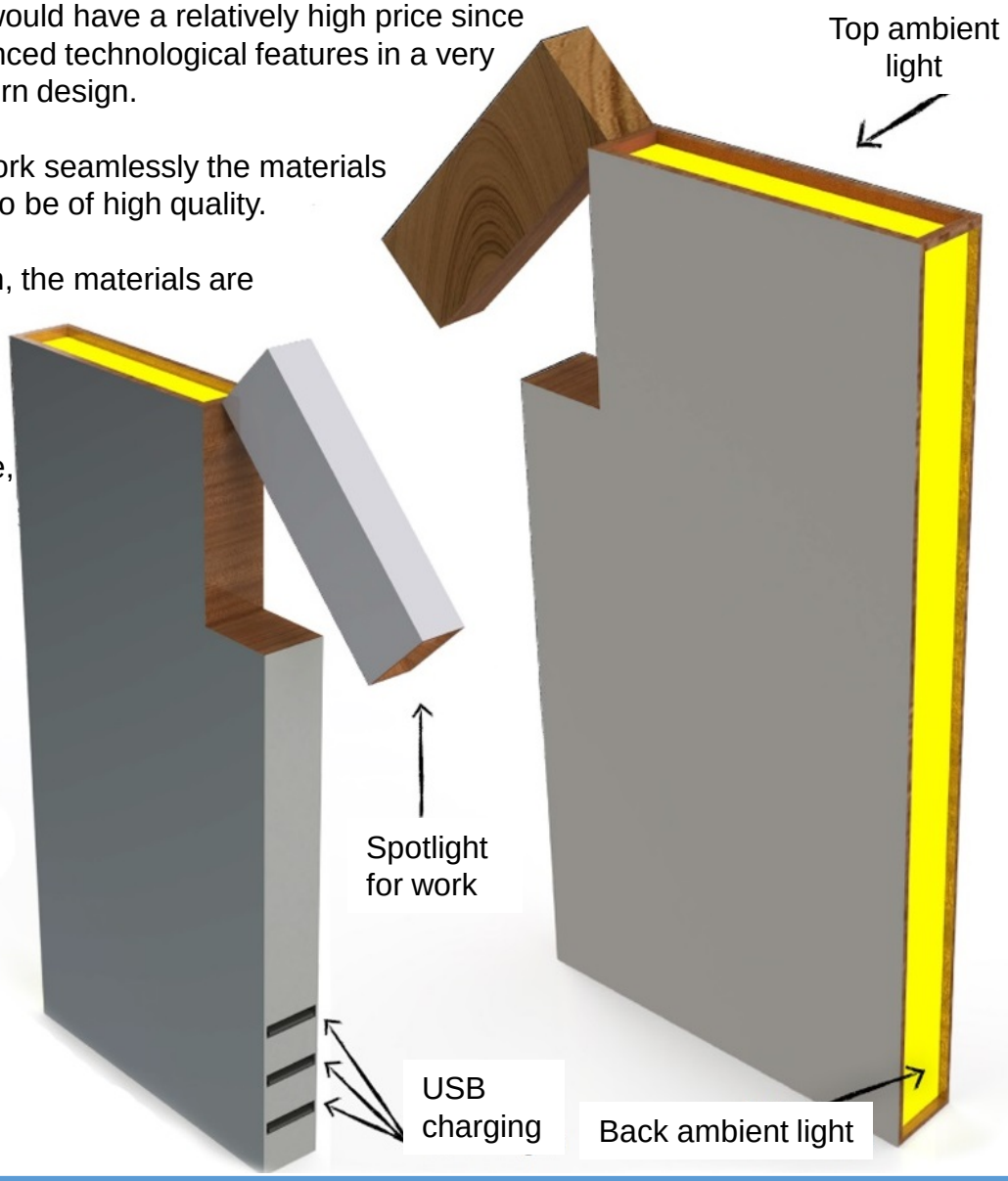
Specification	CAD idea 1 - Satelight
Type of Light	Could use both LED or any other type of lamp. Does not require any specific lighting type and therefore does not make optimal use of the functions of LEDs
Functionality	Combines different types of lighting in one lamp
Materials	Wood and Aluminium
Price Point	£75, since the materials will be very expensive and the R&D which would be required to produce the lamp head would be very time consuming

The focus of the “Light” design was provide multifunctional lighting capabilities and to serve as a USB charging hub and hard drive. The purpose of the moveable element is to enable the lamp to function as a spot light. This moving element could be pointed straight towards work or any other activity that requires intense lighting, and if not required can be click back into the main body. Whilst this “spotlight” would feature a very bright and cold LED light the lighting panels on top and at the back could have a very warm light to serve as an ambient light.

I assume this design would have a relatively high price since it features many advanced technological features in a very slim, simple and modern design.

To make the design work seamlessly the materials would therefore have to be of high quality.

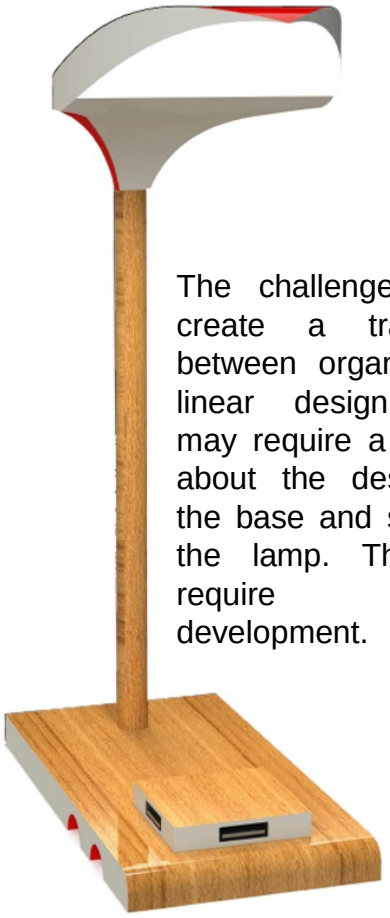
Based on the research, the materials are brushed aluminium and Oak.
A hardwood such as Oak would be relatively expensive, but would increase the aesthetic properties of the product.



Specification	CAD idea 2 - light
Type of Light	The CAD development of the “light” idea focuses heavily on the use of LED. The functionality and diversity of LED technology are at the heart of this Design
Functionality	Focuses on the functionality of the lamp. Acts as a medium to create different moods at the working space. Features USB charging options and a built in hard drive
Materials	Wood and Aluminium
Price Point	This design would cost slightly less and would probably be available around £50. The design is simplistic. The price could vary depending on the electronics included, e.g. Hard drive

As the design of the lamp head is supposed to resemble the shape of a leaf the challenge was to create an organic shape. I immediately faced the challenge of creating a seamless transition between the lamp head and lower part which I envisioned considerably more structural and clearer in design.

Whilst the connection between the base and the top of the lamp might be an issue the overall design of the top is aesthetically pleasing. Also the combination of the green plastic (the natural colour but modern material) and natural hard wood seem to match very well.



The challenge is to create a transition between organic and linear design. This may require a rethink about the design of the base and stem of the lamp. This will require further development.

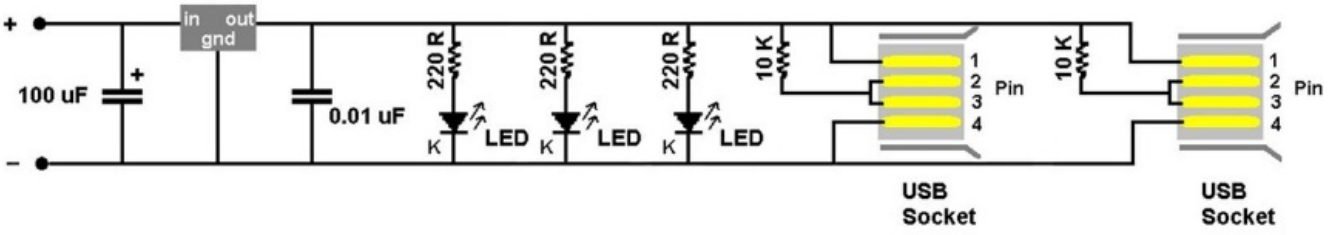
As the lamp head has a very organic design and will most likely hold many different types of electronics, the design of it will have to be very precise and specific. Based on this CAD model I created I think that it would probably be most beneficial if I would 3D print the final version of the product.

Overall I will develop the Leaf design further based on two main reasons: it meets the specifications and the knowledge gained by creating the CAD designs. The research clearly showed that most existing lamps fail to combine both an aesthetically pleasing design and new technologies.

Development of concepts

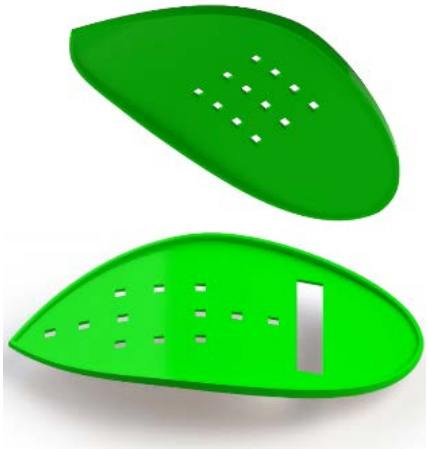
The images show how I engaged in primary research by test cabling USB sockets and trying them with several devices such as phone chargers or USB sticks. Whilst I connected the cables required for data transfer I only tested whether the electricity of the USB sockets since I was not able to connect the socket to any kind of device which would have been able to read any kind of data.

I developed the following circuit in order to protect the USB charger points. The capacitors and the 7805 5V regulator protect the devices from receiving too much voltage through the charger points. Also, I have included three LEDs in parallel that are protected by resistors – the number of LEDs can be increased and inserted in parallel if needed.



The image shows a test lamination I did as part of my primary research. I used plywood and PVA glue bend over a curve to figure out what exactly is necessary during the lamination process.

Even though the models on the right show that Pine, or Balsa are the most flexible woods. My teachers however recommended me to just use Plywood since it is readily available and the staff has the greatest experience with it.

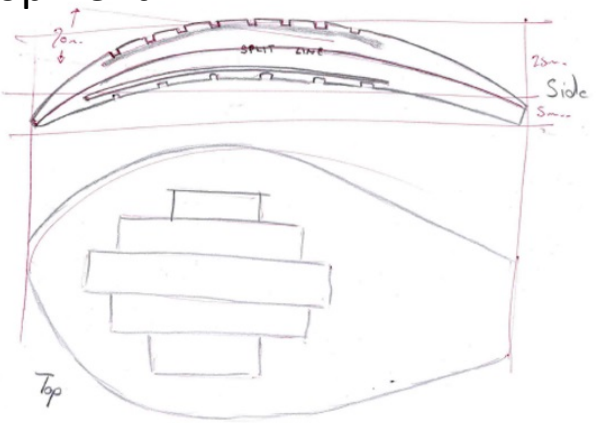


I used Solid Works to develop the top as two halves that can integrate the electronics in a way in which only the lighting diodes can be seen. The two halves will be glued together in the manufacturing process.

This will make it seem as if it was produced as one part, especially once the transition is sanded down. The holes were measured in a way to exactly fit the LED straps. I will expand on the processes used for that in the manufacturing part of the project.

Development of ideas – design development

The primary feature of the design focusses on the shape of the lamp head. It is important to combine its shape with the required technology. The design should maximise the surface area off the lamp head but hide all of the electronic components. The ideal situation would be for the electronics to be housed inside the Lamp head with single LEDs exposed on the surface to deliver optimum lighting.

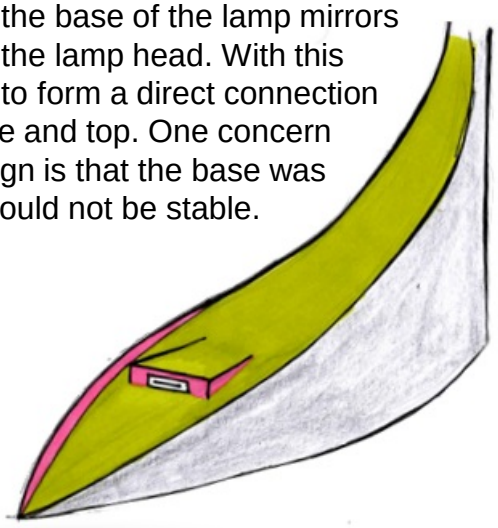


This approach means that the head needs to be hollow to fit the electronics inside. The top needs to be made of two halves, so the electronics could be placed inside These two separate halves After the electronics are installed, the two separate halves could be joined. In this design the components would be visible on the outside

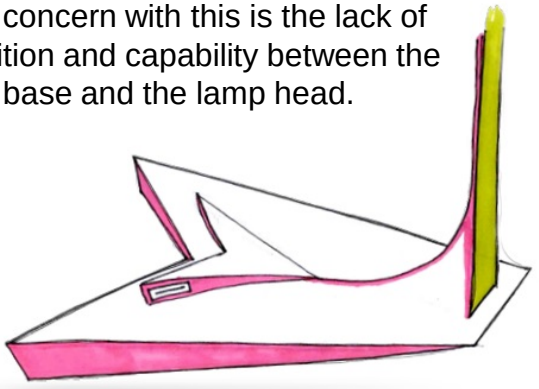
As I said above my main focus of the lamp development was to understand how to optimise its functionality in terms of its lighting capabilities. To develop my idea of giving the lamp head the shape of a leaf to allow for a design with different lighting elements I created blue foam models to consider the lamp head, using a leaf to inform the shape development.
I coloured different areas of the blue foam model to imagine where what type of lighting might be installed.

Developing the base

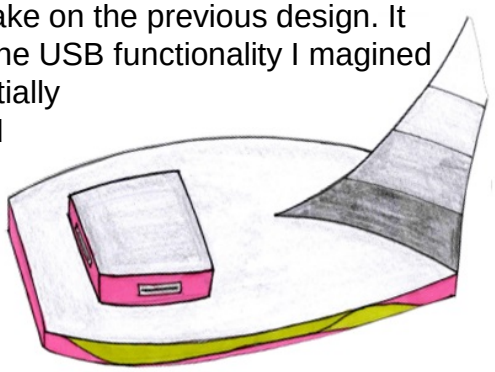
This idea for the base of the lamp mirrors the shape of the lamp head. With this model I tried to form a direct connection between base and top. One concern with this design is that the base was too narrow would not be stable.



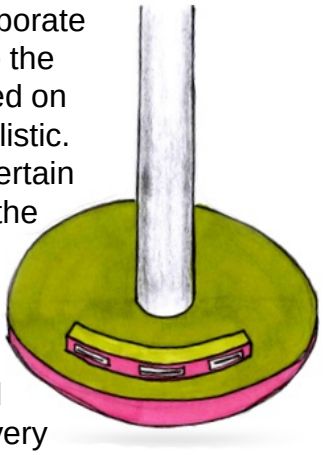
This second idea is based on linear shapes which leads to a more progressive appearance. The USB hub is included in this design. The main concern with this is the lack of transition and capability between the lamp base and the lamp head.



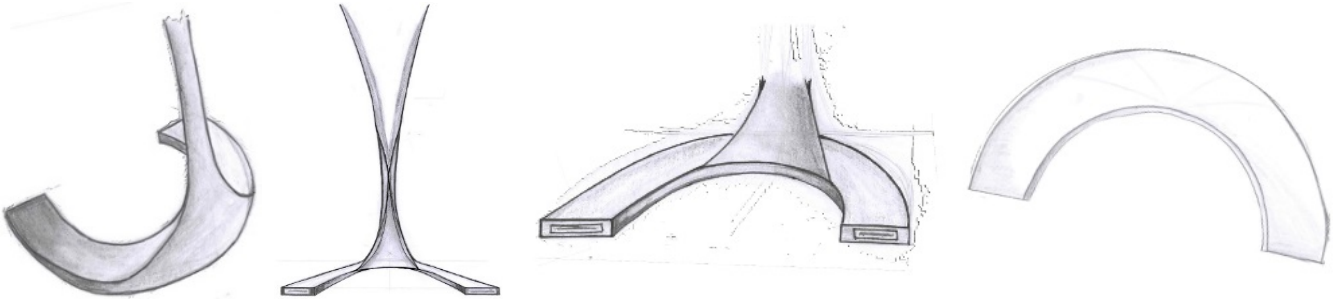
The third design of the base is a rounder take on the previous design. It features the USB functionality I magined when I initially presented the idea.



The last idea contrasts the other ideas very much. I tried to incorporate rideable USB sockets into the design. It is primarily based on round shapes and is simplistic. I am however slightly uncertain how well it would go with the design of the lamp head.



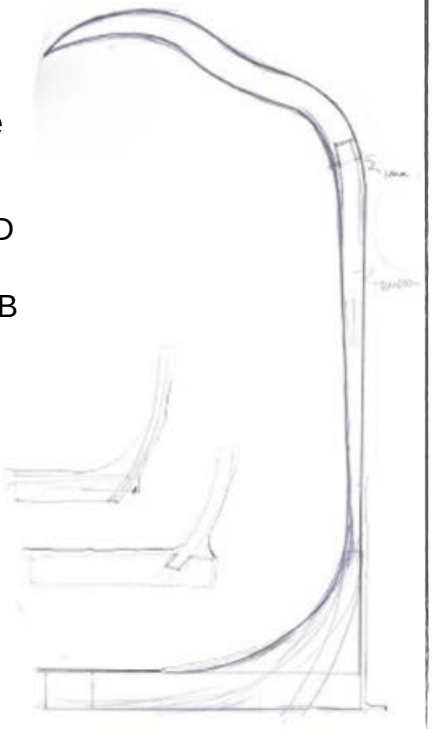
Whilst I had the feeling that some of the lamp base designs are very solid and would make great feet for typical desk lamps I had the feeling with every single one of the designs I created that they were directly competing with the new design of the lamp head. I wanted the focus to be on the head of the lamp and as soon as something is directly underneath the lamp head it looses its spacial significance.



Considering a design which would have no material directly underneath the head, I drew inspiration from the shape of a spaceship in a movie called *Prometheus.* The spaceship has a half ring like structure with two entrances on each end and the central cockpit in the middle. The two entrances would be used for USB sockets. The central area would transition into the stem of the lamp. I think that this design is the most elegant and simple, and looks organic. The design of this base also complements the natural shape of the lamp head.

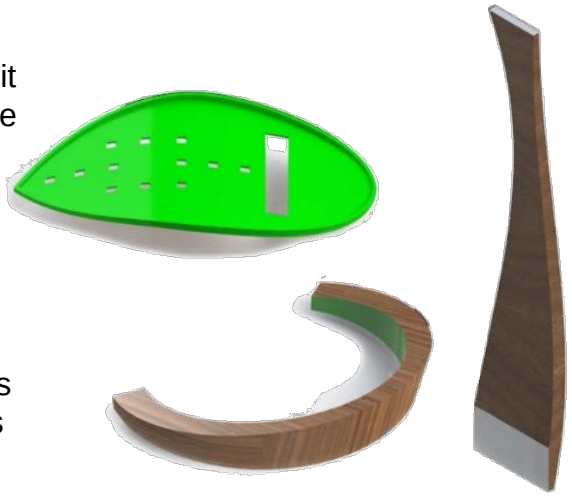
Image of Prometheus starship removed due to copyright

With regard to fixing the back to the base, I thought about the different ideas in the sketch on the right hand side. In the end I decided to go for a slightly angled base that the back would just be screwed on to.



The CAD model below shows the internal structure of the final CAD design on the right. I designed it in a way that cables can easily be guided through the base. Also I used the measurements of the USB presented in the development to choose the size of the holes that would be required for the USB sockets

I developed the stem of the design simultaneously with the base. This was particularly important since it represents the connection between the head and the base. The stem is linear and minimalistic but simultaneously curved and living.



The outcome of that development process is presented on the right.

The cable channel which will connect the electronics from the top to the power supply on the bottom runs through a channel up the stem.

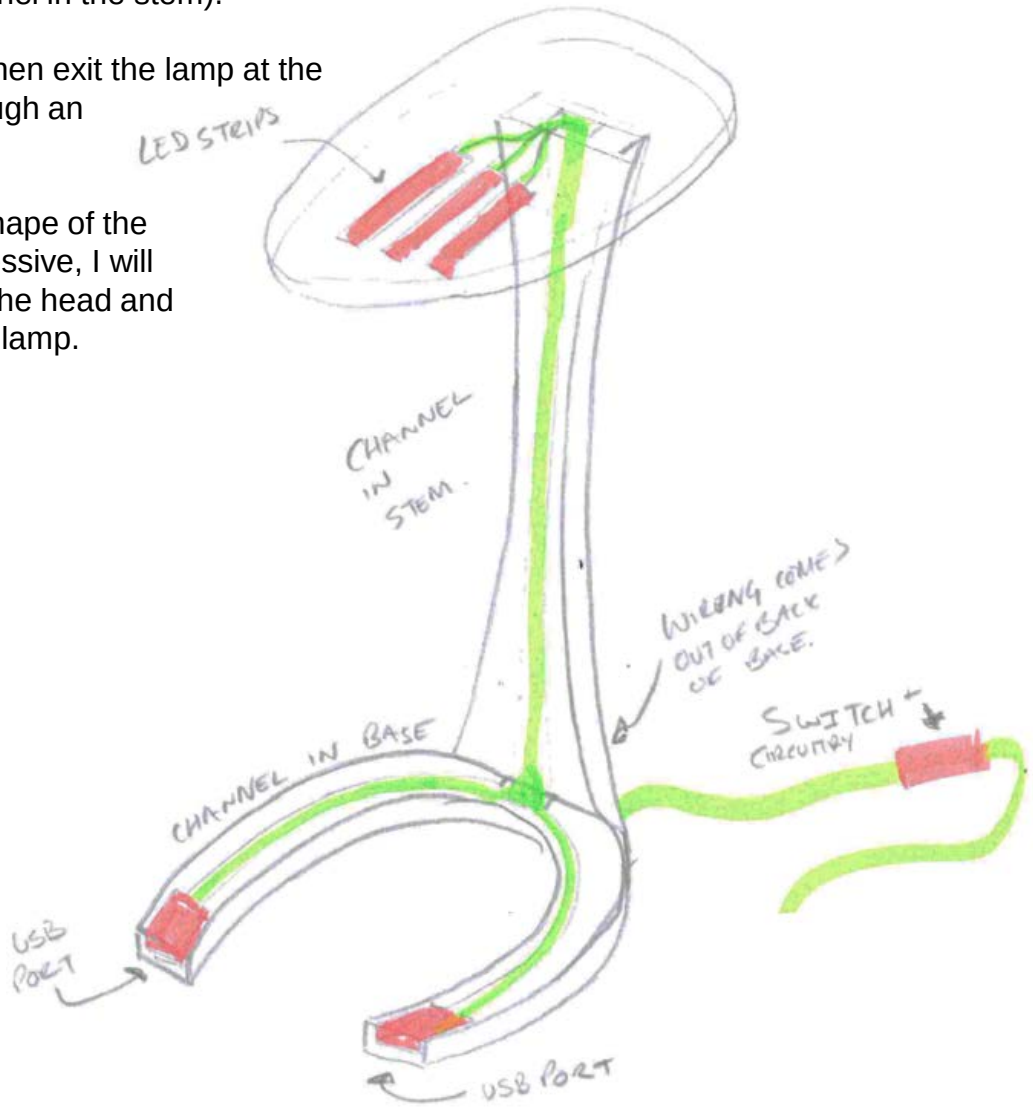
The cabling of the lamp is obviously very important for the lamp to function. Based on the electrics diagram presented earlier in the project, I have accounted for the cabling to be routed through the lamp.

The base, as seen in the sketch has a channel cut into it. This is for the cabling. Using the size of the USB port, I have also made a section for that to fit into.

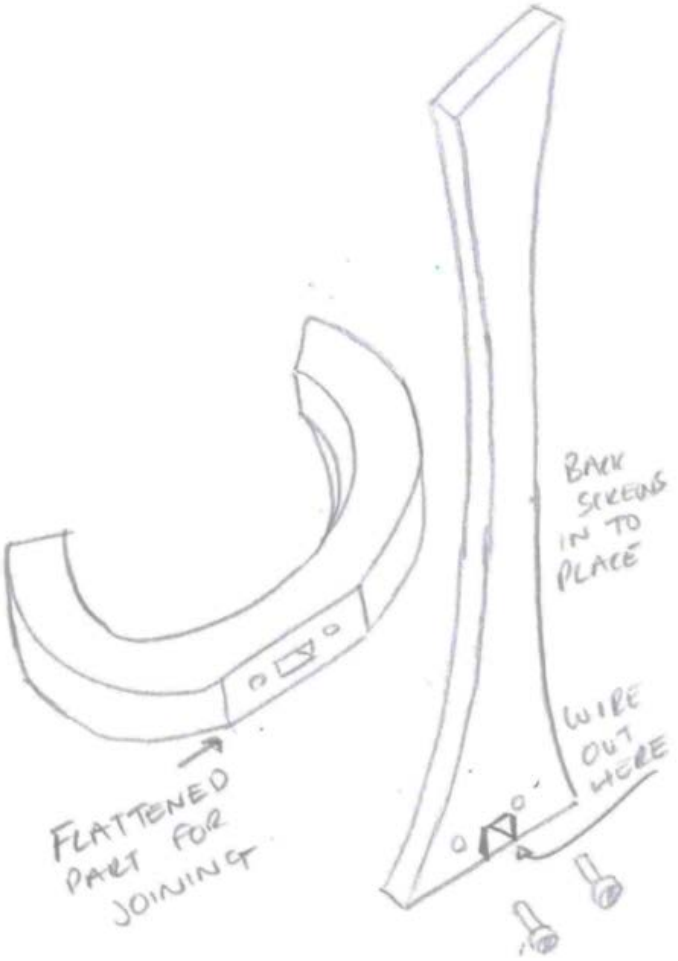
Additionally, the cable can run up from the base to the leaf head, where the LED strips will be through a channel in the stem).

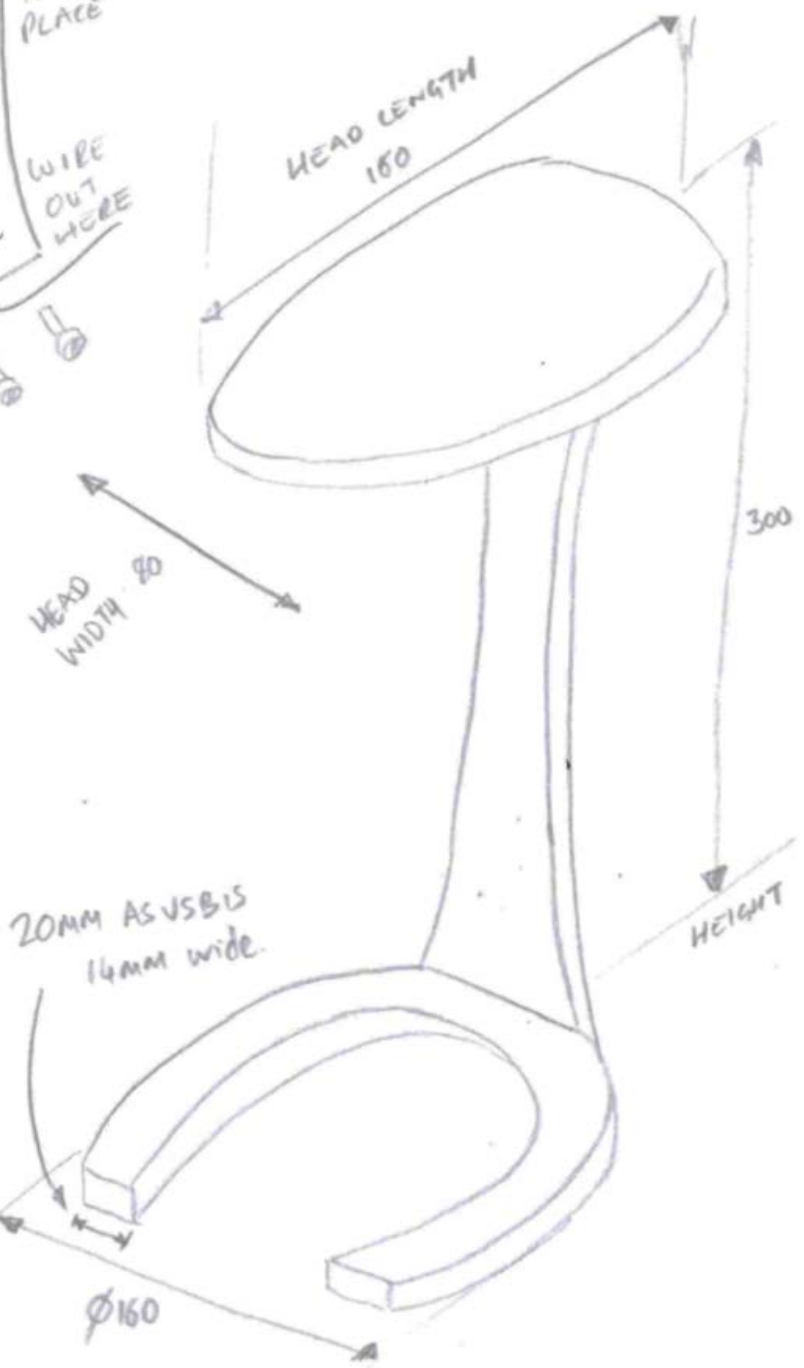
All of the cabling will then exit the lamp at the base of the stem through an opening.

In order to keep the shape of the lamp sleek and progressive, I will house the circuitry in the head and the switch outside the lamp.



I have considered how to join the back to the base, and I think the best way to do this will be to screw/bolt the back in place. This will provide the necessary strength to support the head and stop the base from coming apart.





Sizes

Based on the space available for the lamp, I have determined the following sizes for the lamp.

The maximum envelope for the lamp is 190mm, by considering space for the cable to exit the back of the lamp, the maximum diameter of the base should be no more than 160mm.

Also, the maximum head length should be no more than 160mm in order to be stable.

To keep the lamp in proportion, I will make the total height no more than twice the size of the base (320mm).

+ The cable and electronics have sufficient space to be hidden.
- Creating channels for cabling could prove difficult and add cost to the final design.

Justification of final choice

I have chosen the ‘Leaf’ design as my final design for detailed development. Here I will justify the choice using the Marketing and Design specifications.

Marketing specification:
Target market – This is a stylish and fashionable product that will appeal to the target market – 15 to 35 year olds. It also appeals to the tech savvy people who will have devices that can be charged using a USB point.

Target audience – This lamp caters for the needs of both personae that were identified – the USB integration and fashionable design will have to be developed to be both good quality and to allow regular use.

Market analysis – The choice of LEDs is both functional and environmentally friendly. The lamp follows the trends of the market and enhances the product by integrating USB chargers.

User need – The design of the lamp incorporates potential for different mood lighting, whilst also offering bright light for working with. With the down light and uplight features, it is versatile to meet the needs of the user. By incorporating USB charger points, it will allow the user to keep their desk tidier as there will be fewer cables going across the desk space.

Competition – The Leaf is an example of convergent technology in that the lamp integrates USB charging points. It can also be further designed to ensure that it can be sold around the £60 price point.

Design specification:
Function
1.1 The LEDs will provide about 800 lumen
1.2 The LEDs are low power and will consume 6-8 Watts based on a 12V direct current.
1.3 The design clearly fulfils the functions I imagined in the original specification. It has an innovative design and features the integration of different lighting panels made up of LEDs.
1.4. It features multi-functionality since it allows phone charging via USBs
1.5 The circular base has a small footprint and has been designed to be 180mm diameter. The height of the lamp has been determined as 300mm.
1.6 the design is light in weight as it is sleek and slim. One consideration when selecting the materials will be it’s material weight, although the lamp head will be mainly hollow and be used to reduce weight as much as possible. The base will be designed to be heavier than the head in order to increase stability.
1.7 At this point, I can estimate that the price would not exceed £20 for manufacture – I will need t consider the selection of materials to determine this. This would then allow a retail price of £60
1.8 The design of the cabling allows the lamp to be plugged into a main socket. The transformer will be located externally to the lamp and integrated into the power cable.

Aesthetics and Materials

2.1 The parts of the lamp are fairly simple to be made using CNC machinery and a 3D printer for the head.

2.2 By selecting wood and plastic, the lamp becomes a good insulator of electricity and therefore safe in use. The smooth sleek design means that the lamp will have no sharp surfaces.

2.3 By using a hardwood veneer, it means that it can be finished to a high quality – as it is a natural material, this also adds to the perceived quality and makes the lamp look expensive.

2.4 The base and the stem of the lamp will be finished with veneers of hardwood.

2.5 the surface finish of the wood will be Danish oil, which gives a warm finish.

Target Market

3.1 This has been addressed in the marketing specification and 1.7

3.2 The lamp converges two functions and therefore fits in the gap in the market.

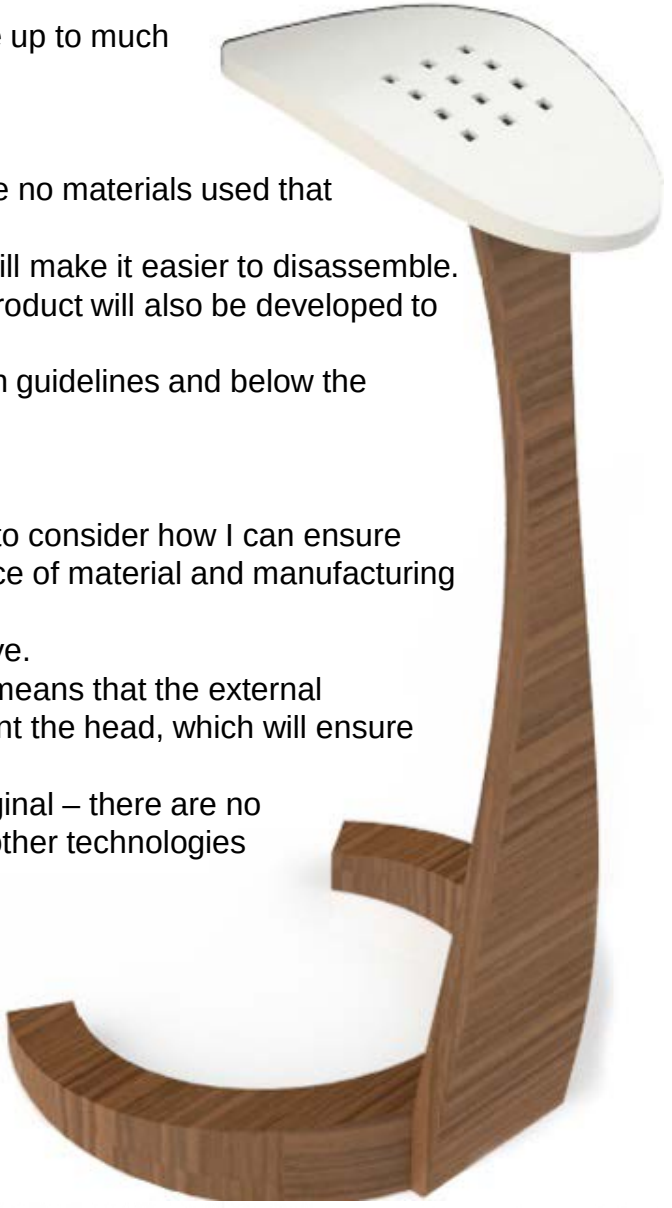
3.3 There is potential to make a range of lamps using different finishes.

Environmental

4.1 The design is suitable to almost any desk kind.

4.2 It is very compatible with other modern desk items especially with modern smartphones or laptops. There are also many USB powered products and gadgets available that could be run through the lamp.

4.3 Due to the shape of the foot it does not take up to much space.



Sustainability

5.1 Wood is relatively easy to recycle. There are no materials used that will be difficult to recycle.

5.2 I am planning to assemble it in a way that will make it easier to disassemble. This includes the electronic elements and the product will also be developed to be easily maintained.

5.3 The power output is within the EC regulation guidelines and below the threshold normally required for electric shock.

Quality

6.1 As I further develop the product, I will have to consider how I can ensure that quality can be maintained through the choice of material and manufacturing processes.

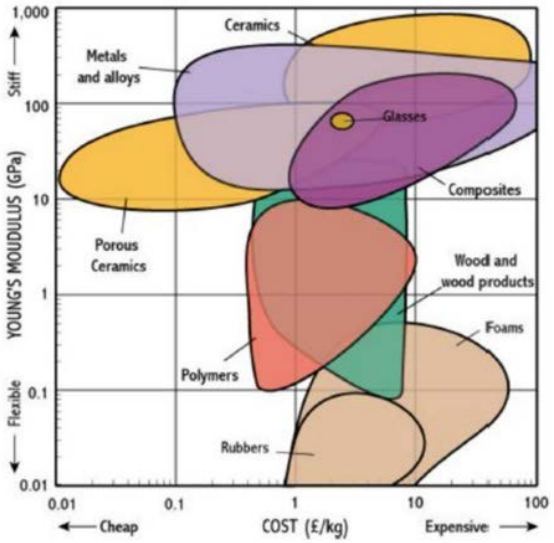
6.2 The design of the lamp is sleek and attractive.

6.3 By using high quality hardwood veneers, it means that the external quality of the lamp will be high. I will also 3D print the head, which will ensure that it is made accurately.

6.4 the design of the lamp is innovative and original – there are no other lamps that look like it and also converge other technologies with it.

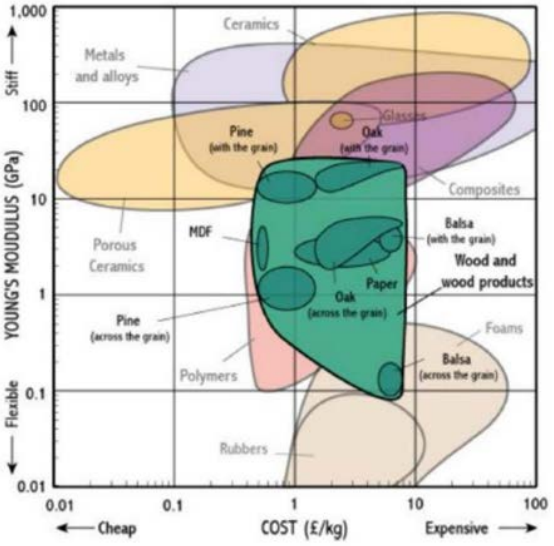
Materials and components for a prototype

The first chart show Young's modulus against cost with the second being a detailed view of wood



From the survey, the potential users indicated that they prefer wood from an aesthetic point of view. As I am considering lamination as a manufacturing process for parts of the lamp, I require a wood which is relatively flexible. From the chart, pine, oak (across the grain) and balsa would offer the greatest flexibility.

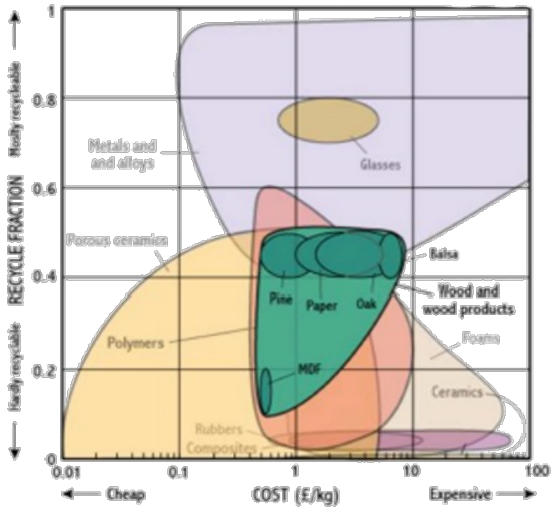
When considering price MDF or Pine would be the best option for lamination. MDF could be veneered which results in a high quality finish at a low cost.



Woods in general are eco-friendly. They are carbon neutral materials. Woods which have a Forest Stewardship council (FSC) logo have been obtained from sustainably run and managed forests and woodlands. Local woods obtained from Europe offer fewer environmental concerns and risk than tropical hardwoods such as mahogany and teak. This is important as woods from tropical areas are often forested illegally.

Another possibility is reclaimed or recycled wood. There are two types of recycled woods: wood that has been used previously and then recycled into a new product; and wood built up of shredded recycled wood such as MDF or chipboard, both environmental friendly and cost effective alternatives to solid woods which are available

The chart on the right compares the Cost of the materials with their recyclability.



Metals and alloys seem to be the materials which are the easiest to recycle whilst it depends on the type of wood whether or not it is easy to recycle.

I researched Aluminium as a material since it was one of the preferences voiced by potential consumers in my survey. Aluminium can be recycled fairly easily and the amount of Aluminium that is recycled is increasing. Only 5% of the energy required to produce primary aluminium is needed to re-melt aluminium for new uses. This makes recycling aluminium very sustainable. Around 75% of all Aluminium ever produced is actually still in use.

The primary production of Aluminium has very profound negative environmental impacts. Especially the emissions of fluoride, SO2, dust and PAH as well as the liquid effluents and the waste disposal are serious concerns. These problems are however almost completely eradicated when using recycled aluminium

The three pieces of veneer on the left hand side have each been processed with different substances. The different products were Varnish, Wood Wax and Danish Oil.

Wood Wax gives a rather dull finish and does not have a polished appearance. In comparison to Danish Oil and Varnish Wood Wax it is really only a short term finish. This means that it needs frequent reapplication. In my test the Wood Wax only changed the appearance of the wood marginally.

Varnish is usually a combination of drying oil, a resin and a thinner. Varnish is completely transparent and results in a gloss finish. Some varnishes can also produce a satin like finish but the particular type of Varnish I used in my test resulted in a glossy look. The Varnish I used dried by evaporation. The process takes relatively long however. Varnish is highly flammable and has to be disposed separately. These environmental factors have to be taken into account.

Danish Oil is primarily made of either tung oil or polymerised linseed oil. It creates a **satin** finish. Besides that it makes the wood water resistant. In comparison to other types of finish it is very easy to apply and only requires very few layers. My test has shown that 3-4 coatings are sufficient to create a rich and deep finish. Since Danish oil is flammable, it is important to ensure that it is applied in a dry area where there is no risk of flames.

Conclusion: I will use the Danish oil. I think it produces the richest finish and best look. It brings out the grain of the wood and darkens it. Whilst the varnish also emphasises the grain it does not have the same richness and saturation to it as the Danish oil.

The head: I only have ABS available to use with the 3D printer. However, ABS is suitable, as it can be coloured using pigments before making enhancing the desirability to a wider range of users. It is relatively strong and tough so will withstand everyday wear and tear. It has a melting temperature above that of the heat caused by the LED console. The surface fish can be smooth or textured depending on the quality of the mould and can easily be wiped clean. ABS is recyclable and can be disposed responsibly at the end of the products life.

Decisions

The materials I have decided to use:

- Plywood for the base as it is a strong, but low cost man-made wood.
- Laminations of softwood for the back as the softwood won't be seen. Softwood is more pliable than hardwood to create the curved shape and is cheaper.
- Walnut veneer for the wood as it is a very desirable material – the veneer is very low cost compared to using a solid piece of wood.
- ABS for the two parts of the 3D printed head as this is the material I have available for the 3D printer.
- Steel plate for fastening the stem to the base, by using steel, it will provide a very solid connection for the base to the stem.

Manufacturing techniques for prototype production

CNC milling

After investigating the different ways I could make the base pieces, I determined I could use 3D printing or CNC routing. As the base would be made out of wood, this eliminated 3D printing, as the 3D printing wood material was not available. For initial testing I will use MDF to test how well the machine would cut my desired shape. Once satisfied, I will then cut out using plywood.
For the prototype, further finishing will be needed, so I will use hand tools to smooth the surfaces before veneering.

3D printing

Due to the shape of the leaf head, 3D printing is more appropriate for making parts out of plastic. I could use hand tools or a CNC router to make the shape, but it would then be more of an aesthetic model, rather than a working part. Also, if I used the CNC router the wall thickness of the head would have to be much thicker than I could make with a 3D printer. The 3D printed part would give me a higher fidelity – it would be more like the final product – and I can test it better. I also have a 3D printer available in school.

3D printing will also allow me to produce hollow and complex shapes very quickly and means that I can tinker with the design of the part to refine the shape. To 3D print a part or a product I will have to design it in a CAD software such as SolidWorks. Once the file is finished it gets exported as an STL file which is than fed into the software which is connected to the 3D printer (in this case by the brand UP!) The printed pieces will not be perfect and I will have to finish it using hand tools and sanding machinery after it has been made.

The plastics I have available for 3D printing is ABS.

Lamination

To make the stem by lamination, I can either use a former, or vacuum bagging. I could also combine hand tools and a CNC router to make the shape out of a solid block, but this would be time consuming and waste expensive material. I will build up the curve using lamination techniques, using think strips of flexible wood to mould the shape.

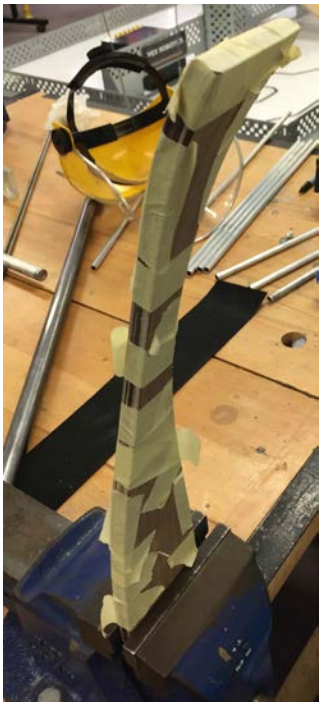
Vacuum bagging would be quicker and easier, but I don't have that equipment available, so I will have to use a former and 'hand-lay' the veneers of wood. This will also allow me to be more accurate when I make the cable channel.

I will create a former using blue foam to create a guideline for the wood layers. I need the back piece to be curved since one of my outcomes from the research of existing products was that most lamps feature a very standard design.

Since the glue takes a day to set I will have to apply pressure on the new layers added to the design using two straps which were strapped around a working bench in the department, and by clamping them in place. I also will use weights to ensure that the new layers would have no air in-between them.

Even though this process is time consuming, for a prototype, it is the easiest way that I can make the shape apart from by cutting the shape from a solid block of wood, which is expensive and wasteful. If I went into production, I would consider cutting from one solid piece as the final product would then be determined. I will also have to consider how the cable will run through the back piece. By laminating the prototype, I can create a channel for the wire to run through.

Veneering



Apart from the lamp head I will veneer all the different parts of my product to give them a uniform high quality appearance. As I outlined at an earlier stage in this investigation many consumers decide whether or not to spend money on a product based on their assumptions of its quality. By using a hard wood veneer the product is on the one hand aesthetically more pleasing and on the other has a richer and more natural feel than for example MDF. I chose Walnut as a veneer since it had a very nice dark appearance. To veneer the different parts of the product I will have to construct different techniques to ensure that the veneer would bind with the glue and the underlying material at all points and that no air would be trapped. I will use a variety of clamps pressurise the veneer at several different points and control how much pressure is on each point so that it will bind with the underlying material. When laminating the back part I will use the same construction for the back part of it. For the inside curve I will have to use tape to hold the veneer onto the laminate while the glue dries.

By laminating, the prototype cost is kept low, as using veneers is much cheaper than making parts out of a solid hardwood.

Decisions

Manufacturing techniques

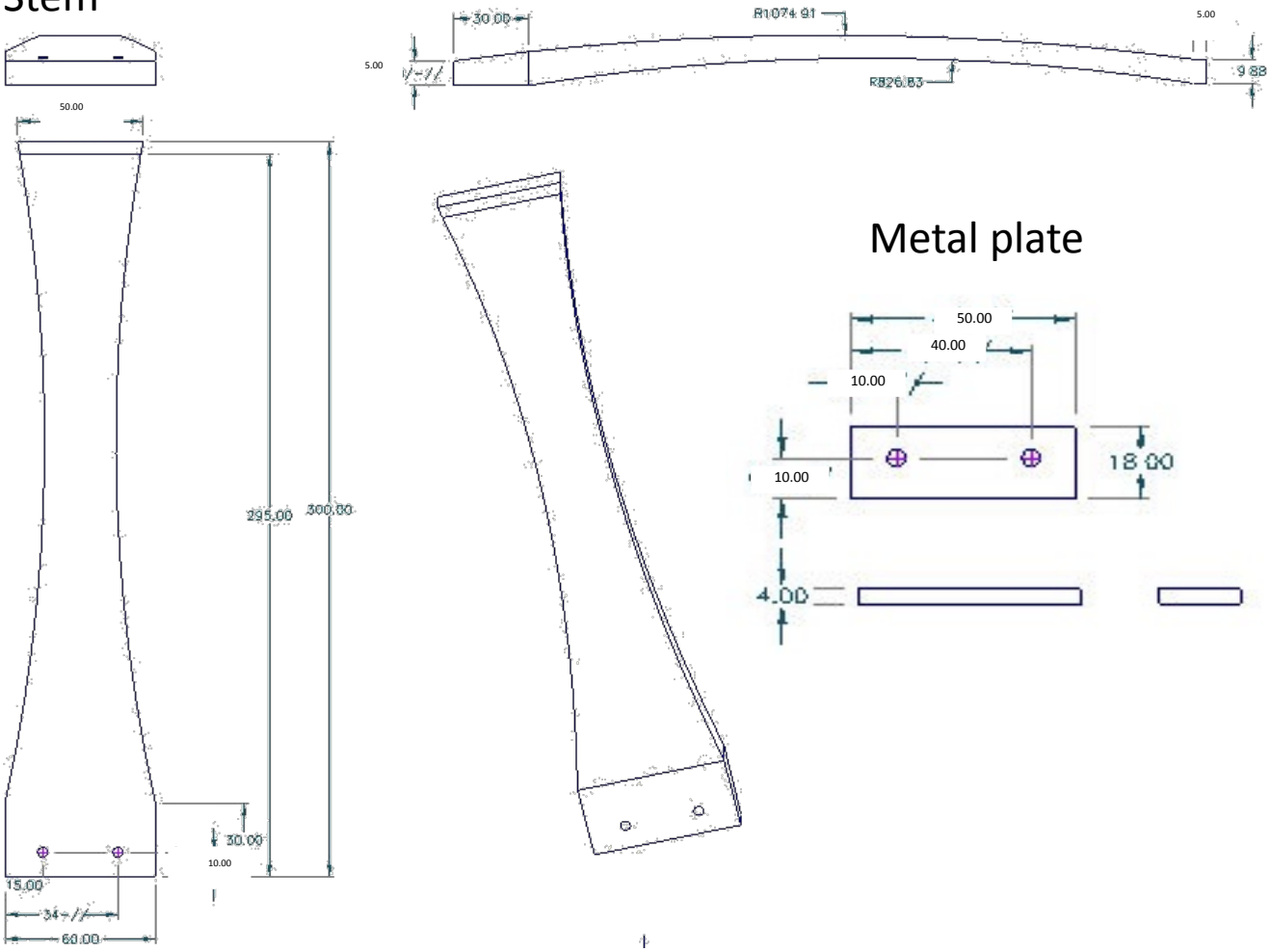
- CNC routing for the plywood base.
- Lamination for the back to easily create a curved shape with a channel using available equipment.
- Veneering for the base and back to provide a high quality finish at low cost.
- 3D printing for the head as it is a complex and hollow plastic shape.
- Screwing and gluing in assembly to ensure that the product is sturdy and well built, but can also be maintained easily.

Standard components are good to use for electrical and fastening components as the are to a standard and reduce cost. Those that will be used are:

- M4 screws to attach the back to the base.
- USB ports
- LED strip lighting (see page 3)
- Standard electric cable

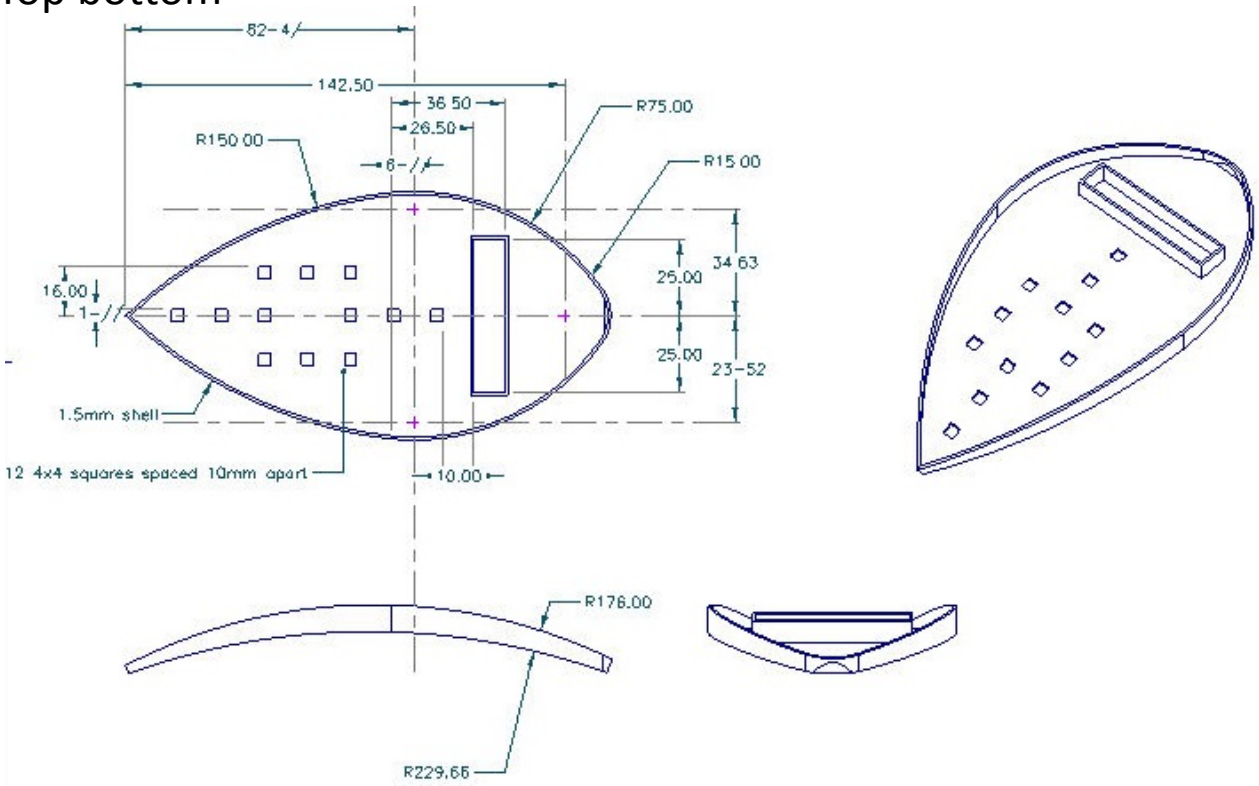
Working drawings for manufacture

Stem

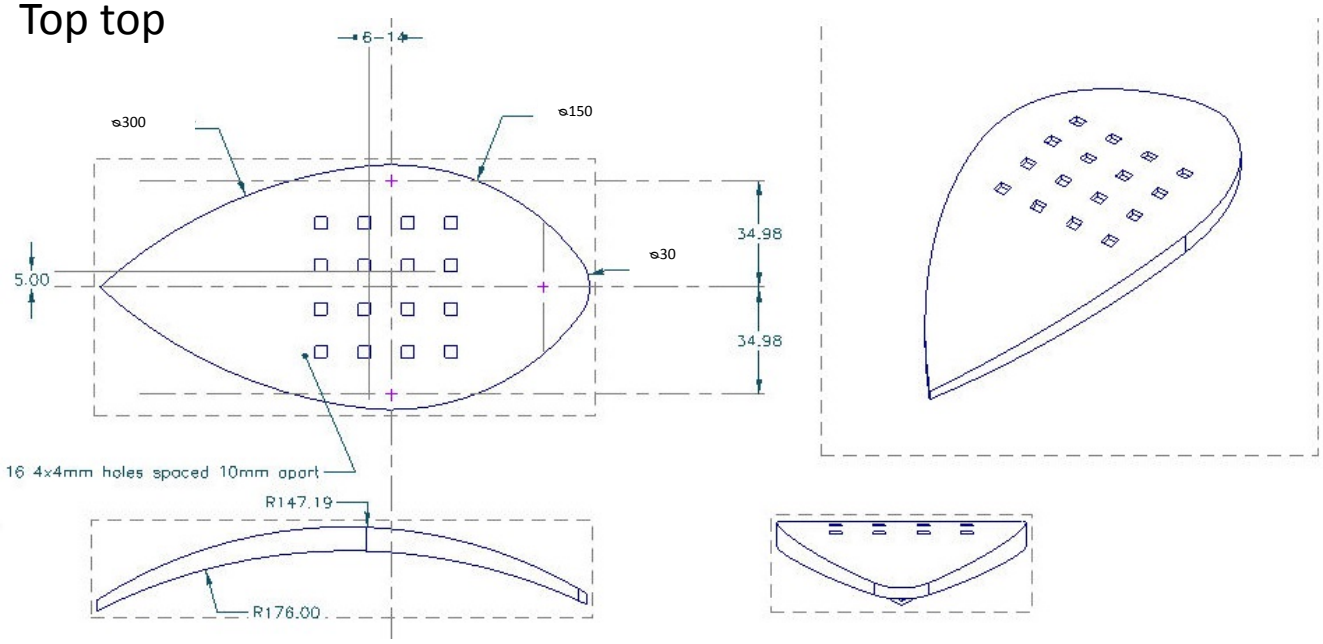


Metal plate

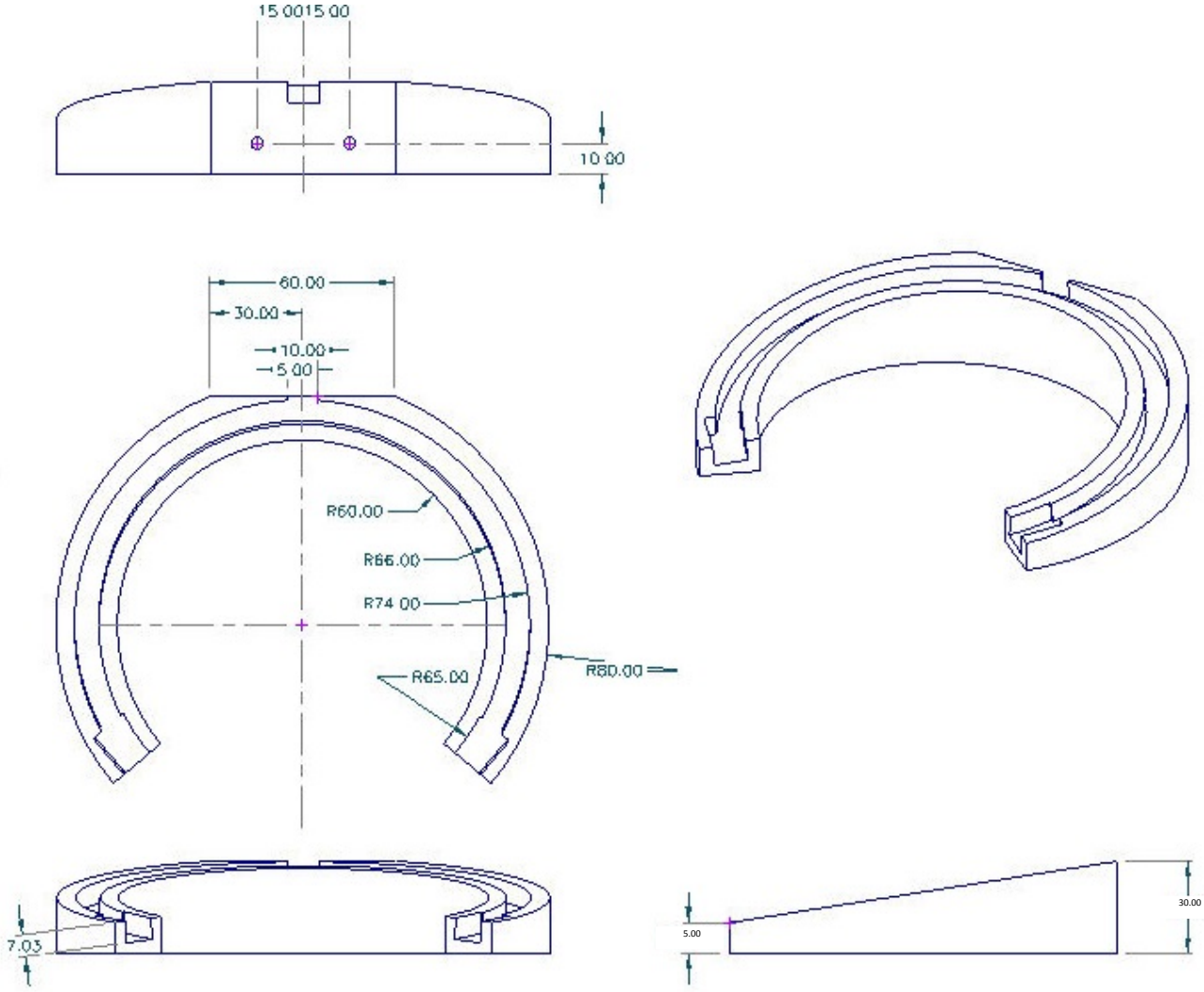
Top bottom



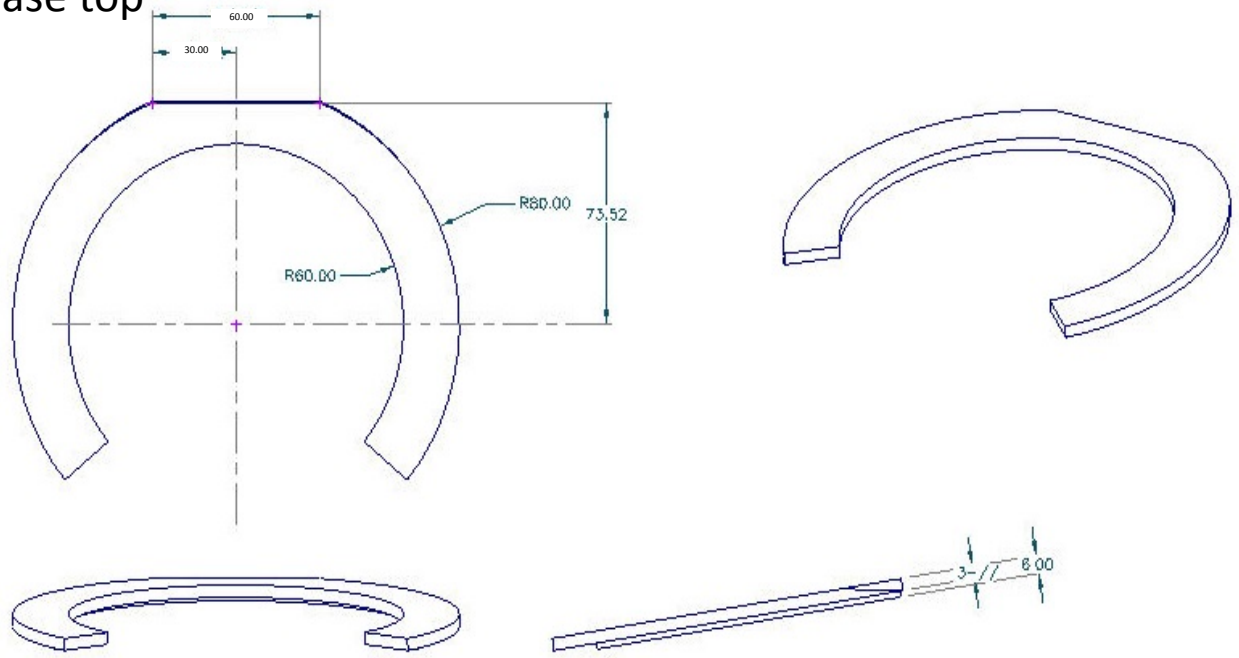
Top top



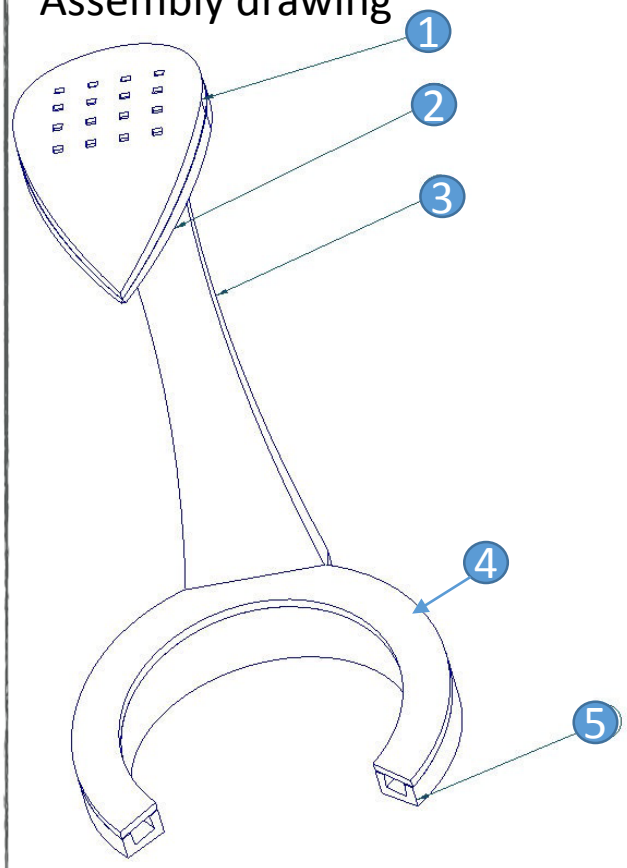
Base bottom



Base top



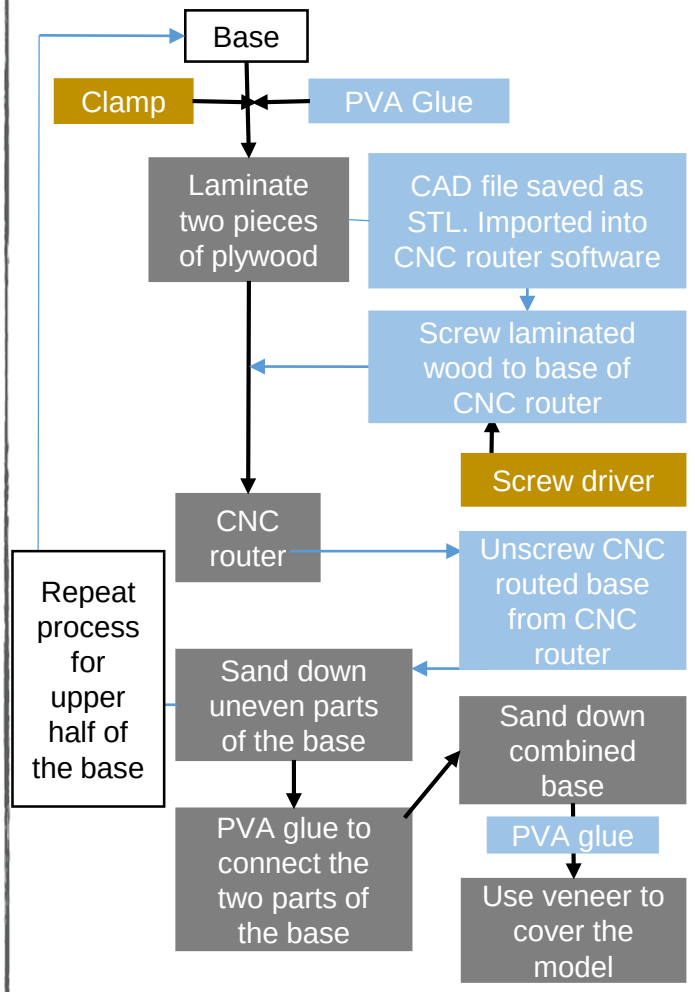
Assembly drawing

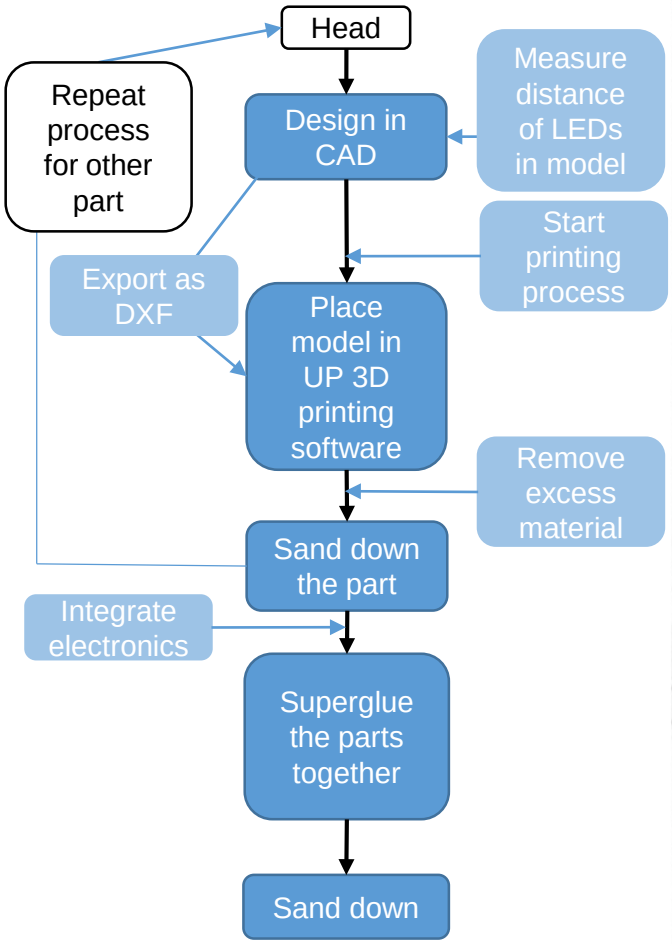


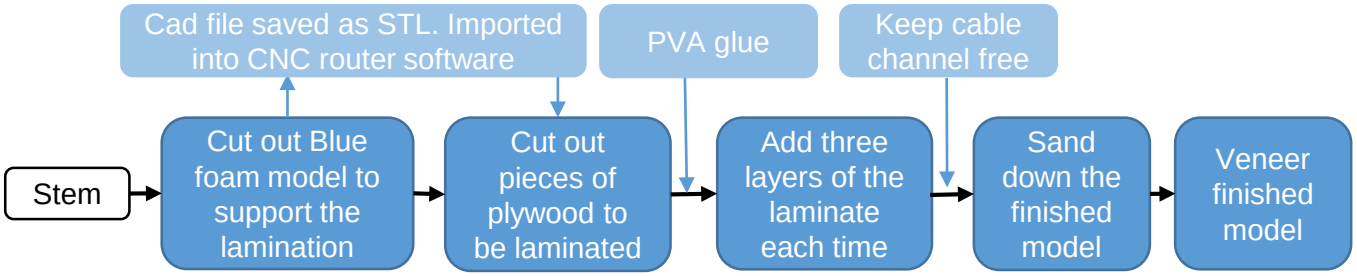
Component list

ID	No. off	Part name	Material
1	1	Top top	ABS
2	1	Top bottom	ABS
3	1	Stem	Veneered plywood
4	1	Base top	Veneered plywood
5	1	Base bottom	Veneered plywood
	1	Metal plate	Steel
	2	M4 Screw	Steel
	2	USB socket	
	2	10k Resistor	
	3	220 Resistor	
	1	100µF Capacitor	
	1	0.01µF Capacitor	
	1	7805 5V Regulator	
	1	Circuit board	
	.5m	Circuit wire	
	3	LED strip	
	1	UK plug	
	1.5m	Power cable	
	1	Finish	Danish oil

Plan for the manufacture of the prototype



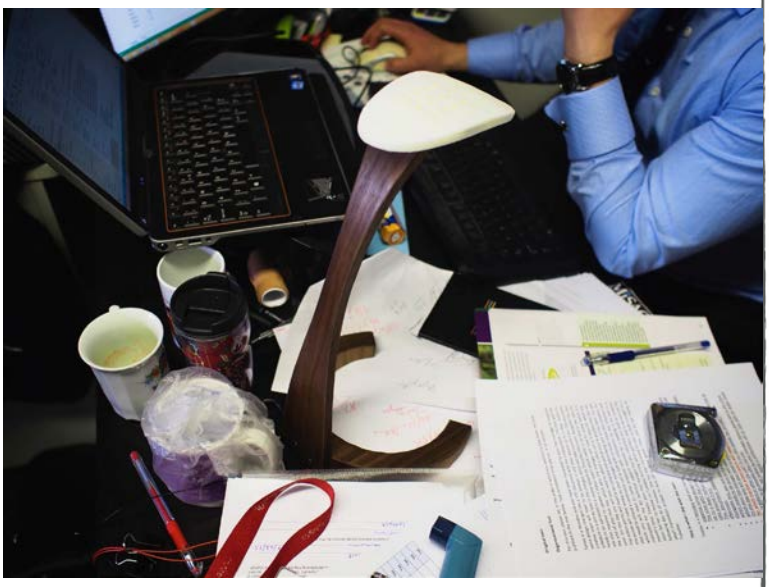




Part	Image	Techniques	Materials	Machine	Time	Health and Safety
Base		CNC routing, Sanding, Veneering, Threading	MDF Plywood Veneer	CNC router Sanding machine	5 hrs	Wear face mask.
Stem		Laser Cutting, Laminating, Veneering, Sanding	Plywood Veneer	Laser Cutter Working bench Wrench	10 hrs	Supervise laser cutter to prevent potential inflammation.
Head		3D printing, Sanding, Gluing	ABS	3D printer	½ hr	3D printer head can become hot. Caution is required. Wear gloves when using super glue.
Cable		Soldering	Solder	Soldering iron	2 hrs	Soldering iron can get hot. Avoid breathing steam created by heating the solder.

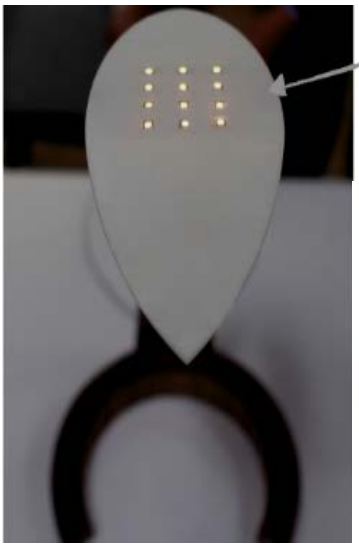
Testing for evaluation

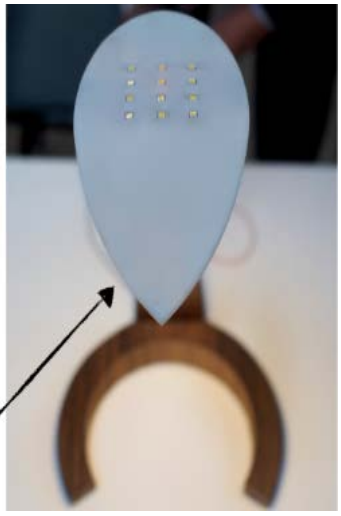
The prototype almost achieved all functions intended. It features two LED lamps: one panel on top of the lamp head and one below both of which can be turned on and off individually. This enables users to create the perfect lighting for their tasks. Even though the USB sockets were cabled up and included in the prototype, I was unable to power them due to complications with a transformer. Despite the two LED panels being integrated properly and fully functioning fully they could not change colour. This was due to availability of white LEDs only. These components could however be changed very easily and a colour control added.

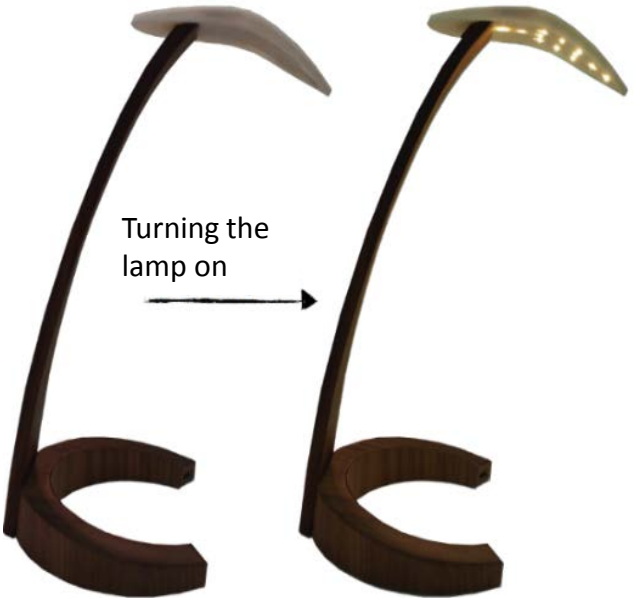


First Application (Real Life Situation): Messy desk, full with paper work, many different electronic devices. The pictures show Dr. X, a biology teacher at Wellington college working on his desk with the lamp. He agreed on testing the product for two days and give me unbiased feedback on it. (Test results are presented on the next page) Whilst he belongs into the target group and according to him enjoys progressive and modern design his desk is fairly messy and lacks any kind of structure and order. Clearly the design was not intended for such an environment nevertheless I think that the design increases the overall structure of the desk despite the mess. It's design is almost eliminating the chaos to a certain extend since it adds a kind of calmness and linearity.

The desk left shows how the product was actually imagined. The "Leaf" was originally imagined to be used in a modern desk environment like below. The design was supposed to help the consumer keep a desk like the one below tidy and help to integrate their phone charging in a natural way. The design would especially compliment a desk made out of a dark hard wood (like the one below) since the lamp itself is primarily veneer with american black walnut. The lighting itself would compliment the desk design and the two parts of the lighting system illuminate the entire surrounding
in a natural.







I ran user tests with members of the target market by giving the prototype to two young(ish) teachers and three students each for two days. They tested the product with a “switching mode power supply” set to 12V so they could control the brightness of the lamp. After each testing period I interviewed each person.

All five people I asked to test the lamp were instructed to actively use it. All stated that they would use it in their everyday situation. Three users said that it was very easy to use, and two said that the “switching mode power supply” was distracting from the intuitive use of the product. This would have to be improved immediately if the product should be sold.

All users said that they thought there was a major difference between my lamp and conventional desk lamps. They stated the design was the innovative as it was clearly distinguishable from all other desk lamp designs they have ever seen before.

The teachers commented on the functionality of the two lighting panels. They said that the single lamp provided sufficient lighting for working and when only using the desk lamp they said that the light output was balanced well. They thought the design was innovative and appealing.

Three out of the five people said that they would buy the lamp for approximately £70. One student stated he was limited to £25 due to his budget. One teacher indicated that he would pay £150 if the design flaws were resolved. This leads me to believe that retailing the product at around £60-70 is realistic.

All parts with limited functionality were mentioned. Everyone said that the USBs should be properly cabled as well as the pluck. Two students suggested the addition of a coloured LED strap rather than a white one on the upper panel of the design

All five people indicated that the lamp fulfils it’s the design brief. However they said that the lack of functionality of some parts of the lamp reduced the sense of quality. One teacher and two students suggested that if the top was manufactured out of wood rather than plastics, it would increase the quality. This can be taken into consideration if the product would be produced on a larger scale.

Evaluation against marketing specification

Target market and audience

The product has been received well by the two main customers that will buy this product. From the feedback, all of those who tested the product fit in these two categories. The feedback was very positive from all. The lamp has been designed as a stylish and technological product and allows the charging of two USB devices when the lamp is connected to a power supply.

Market analysis

Comparing my design to the lamps that are currently on the market, it should sit well in a store that sells contemporary lights, and also in stores that sell technological products. The addition of the USB charging ports means that this would be suitable for sale in Student towns and in design shops.

User need

The indications from the users is that the lamp is:

- Easy to use,
- provides multiple lighting functions – for work and to set a mood,
- can charge more than one USB device,
- reduces the number of cables going across a desk,
- is convenient to use,
- helps the desk to remain uncluttered and messy,
- is a progressive and modern design.

Unfortunately, I couldn't get the lamp to include a light colour changing mode, but this will be something I will develop as part of the commercially made product.

Competition

Even though the competition is high, the people who I interviewed indicated that the £60 target price is fair, and one of my teachers indicated that he would spend a lot more money on a product that looked so good and functioned well.

If this lamp was released on the market, it would get a lot of attention because it does save the user space on their desk, offers multiple light modes, and means that they can plug in their devices to the USB for charging. Not many other products do all of that and look aesthetically pleasing.

Evaluation against design specification

Function

1.1 The "Leaf" provides light intensity between 100 up to 1000 lux which allows for different tasks even in complete darkness. The flexibility of the light intensity was also confirmed through product testing. The users found the light to be adequate and comfortable.
1.2 Low Power, low profile LEDs ~12V OC were used but they can not change colour at this point – the addition of a colour changing module would add to the cost.
1.3 The feedback gained through the testing was that the product is aesthetically pleasing and very innovative. They stated that the shape was definitely unconventional and appealing.
1.4 The Product has been designed to feature multi functionality like in the form of the USB charging points and two lighting panels to adjust the l light for different situations. I was unable to incorporate the USB charging points into the prototype, and therefore was unable to test them.
1.5 The size of the base is 180mm diameter. This allows the lamp to fit within the specified constraint. The height is 300mm, again, within the specified constraint.
1.6 The product weighs 1.3kg, with the base being the heaviest part. It is stable in use.

1.7 The materials used to make the lamp cost about £11.50. Adding the time took to make the lamp, it would be considerably more, but I would adapt materials and processes for commercial production to achieve economy of scale, significantly reducing material and production costs.
1.8 The lamp is powered by mains electricity, but I need to use a switching mode power supply to act as a transformer. This reduces the voltage to 12 V, which is required for the LEDs to work. I was not able to include an integrated transformer into the power cable, and this will be something I will have to consider for commercial production.

Aesthetics and materials
2.1 The product was designed and made in the workshop using available materials and tools.
2.2 The design and materials were chosen in regard to the function. I used wood and plastic as good electrical insulators that were easy to work considering the available manufacturing techniques. 3D printing allowed me to polish the head parts to a good quality, and I was able to finish the wooden parts with the walnut veneer and Danish oil.
2.3 The materials of the base and the back are very high quality but the 3D printed part could be improved in appearance. If I was to commercially manufacture the heads using 3D printing, I would need to look at increasing the resolution of the print.
2.4 The base and stem of the lamp have been finished using a high quality walnut veneer. The users I tested the lamp with said that they considered the quality finish of the lamp to be high.
2.5 The Danish oil finish protects the wood from everyday use and spillages.

Target market
3.1 According to the testing, the product appeals to older pupils and young teacher. This is the target market that I aimed for as described as the personae.
3.2 The market gap was filled to the extend that the lamp improves the organisation of the desk. If the USB charging points were connected in the final prototype, this would further fill the market gap by converging the two technologies of lighting and USB charging.
3.3 The users indicated that they liked the high quality walnut veneer as a finish.

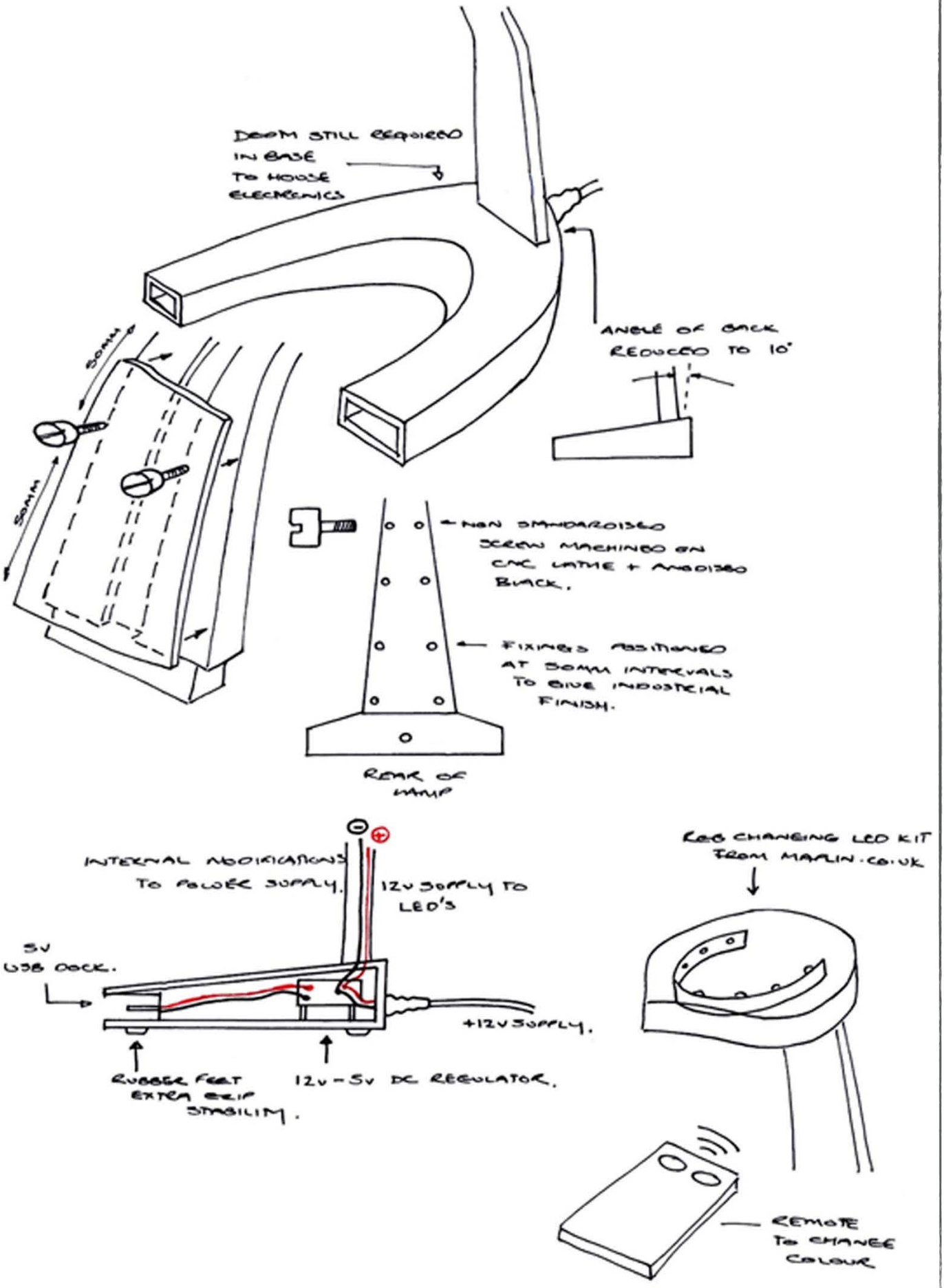
Environmental
4.1,3 The “Leaf” design fits almost all desk sizes and due to its base design does not take much space. The design of the lamp is modern and stylish and the users indicated that they would be happy to purchase the lamp as it fits in with their sense of fashion.
4.2 It is compatible with most items on the average desk of the target market. Especially with the USB charging functionality for electronic devices. The style of the lamp also fits in with the sleek and modern shapes of Apple products and other technologies.
4.3 The limited testing shows that on a cluttered desk, feedback shows that the lamp added to the sense of calmness. On a clear modern desk, the lamp looks appropriate.

Sustainability
5.1 The wood and ABS components are recyclable and the lamp is easy to dismantle. Some areas are glued, which makes disassembly more difficult, but redesigning the lamp head, for example, to clip together rather than be glued would increase the recyclability of the lamp.
5.2 The woods used are relatively eco friendly and sourced from FSC sources. ABS is a thermoplastic and also recyclable.
5.3 The product conforms with the European regulations identified in the research. The power output using the switching mode power supply is within EC regulations and below the threshold for electric shock.

Quality
6.1 Throughout the making of the lamp, I referenced the specification to ensure quality control
6.2 According to user testing the appearance of the product is of very high quality.
6.3 The materials used in the process are of relatively high quality. MDF and Plywood as core material for the veneer could be replaced by higher quality materials, but they are eco-friendly.
6.4 According to user testing and personal judgement the design is innovative and original

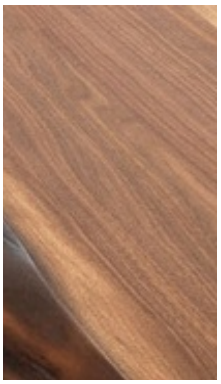
Improving the solution

Part	Image	Functions	Flaws	Possible improvements
Base		• Holds USB Sockets. • Function orientated design. • Space saving design. • Cable channels to lead cables from USB sockets to the back without being visible.	• USB ports are not yet connected. • Cable hole at the back is to small. • Veneering could be done to a higher standard.	• Connect the USB to the main power source properly. • Improve quality of Veneering by spending more time and attention to detail. • Alternatively make lamp base out of solid wood.
Stem		• Leads cable. • Builds the design back bone. • Innovative design.	• The angle was perceived as to steep. • The screws in the back were not 100% even with the Veneer.	• Angle the stem less by adjusting the base • Increase the size of the holes in surface to fit screws properly. • Instead of covering the screws, make them into a feature of the design.
Head		• Lighting. • Main design element. • Two lighting panels which can be controlled separately. • Upper panel can create different colour.	• The finish of the lamp top was not on one level with the finish of the rest of the lamp. • The upper panel can not create different colour	• Improve finishing of the lamp top by sanding out imperfections and colouring it white to make the colour more even. • Change LED panel on top to change light colour.
Cables		• Connects USB sockets to power supply. • Connects LED panels to power supply.	• Power only run with “Switching Mode Power Supply”. • USB sockets are not connected to the power source.	• Connect the cables so that they can be plugged into a normal socket. • Connect USBs.


DOOM STILL REQUIRED IN BASE TO HOUSE ELECTRONICS
ANGLE OF BACK REDUCED TO 10°
50MM
50MM
NON STANDARDISED SCREW MACHINED ON CNC LATHE + ANODISED BLACK.
FIXINGS POSITIONED AT 50MM INTERVALS TO GIVE INDUSTRIAL FINISH.
REAR OF LAMP
INTERNAL MODIFICATIONS TO POWER SUPPLY.
12V SUPPLY TO LED'S
5V USB DOCK.
+12V SUPPLY.
RUBBER FEET EXTRA GRIP STABILITY.
12V - 5V DC REGULATOR.
RGB CHANGING LED KIT FROM MAPLIN.CO.UK
REMOTE TO CHANGE COLOUR

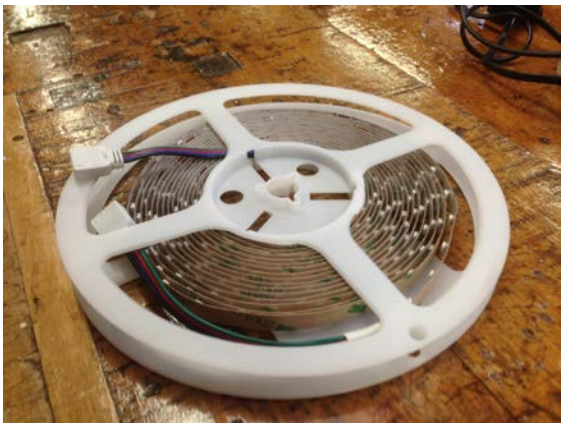
Commercial production

For commercial manufacture, I want to create a more luxury item. The feedback I gained from the model was that the Walnut veneer was very desirable, so I for commercial manufacture, I will use solid walnut. This will add ‘extra weight’ to my desk lamp and help it stand steadier, and also give the user a feeling of quality.



This also means that making the base and the back out of solid wood, they can be made using automated production, the most appropriate would be using a CNC milling machine, although this would create some waste.

An advantage of using solid wood is that it is not too expensive per lamp, but can be made using one process rather than the several process I used to make the prototype. The materials can also be sourced from a sustainable forest. This means that the worlds forest and supply of timber will not be diminished to make the product and the carbon that was used to make the wood will be locked in the components of the lamp.



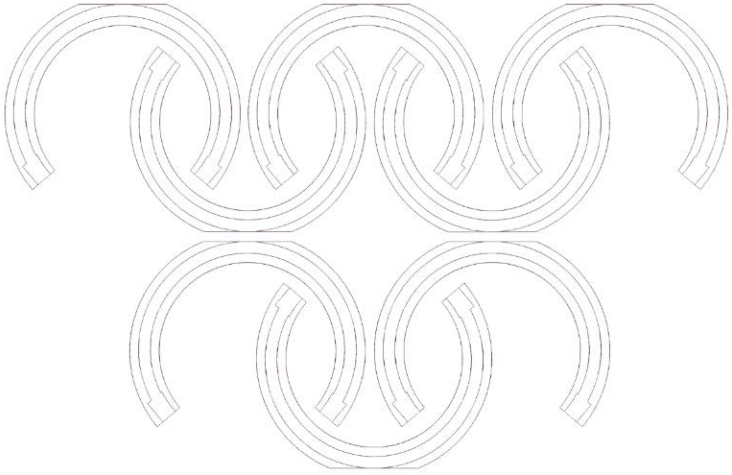
Additionally, I would buy in the circuitry and cabling from a supplier for the electronics. I would upgrade the LEDs to be colour changing. That way, the lamp can also be used to create different moods and ambient lighting.

Using the strip LED lighting makes it very easy to fit to the lamp. The strips can be fastened in place with a sticky pad, and not require permanent fixings. This means if they break, they can be replaced easily.

The screws that are use to attach the base to the back are standard size M4 screws, By using these screws, they can be bought in to the assembly line and costs can be lowered.

When finishing the wooden parts, I will still use Danish oil. Unfortunately, this means that the application will be done by hand, but the results are definitely worth it. This would then be the most labour intensive part.

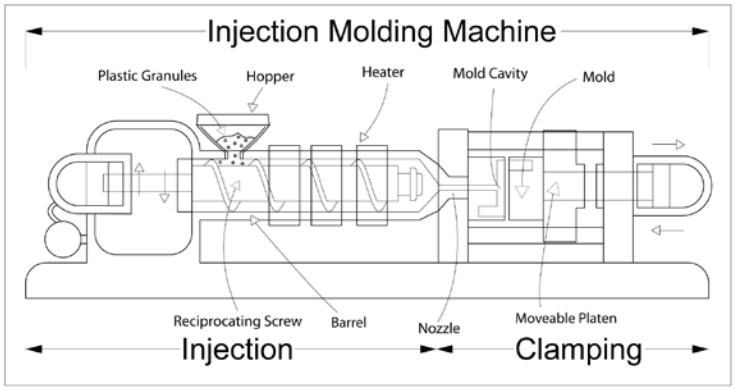
In order to minimise the waste material, the base pieces would be arranged in an array as per the drawing to the left.



Both the top and bottom pieces of the base would be routed like this.

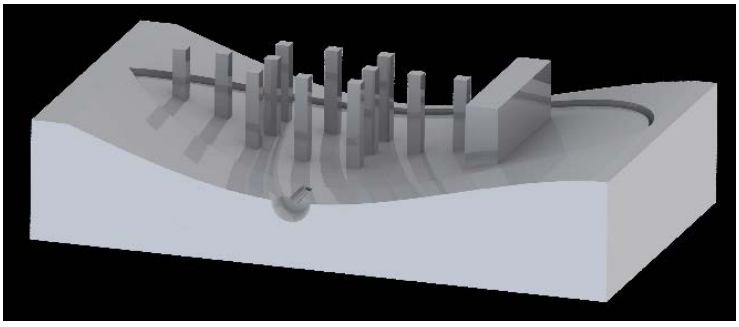
In order to cut the angle on the base bottom and drill the holes in the back, jigs would need to be developed in order to hold the piece firmly while performing these actions.

Part	Image	Modifications for commercial manufacture
Base		Producing the base is not to difficult nor to time consuming. The process would be suitable for a larger scale production. However, in order to increase the quality of the product for commercial sales, I would modify the base to be made out of solid wood. This would be two pieces that could be CNC routed.
Stem		The laminating is by far the most time consuming part of the process. The piece could be made out of two solid pieces of hard wood which would be steam bend later on in the process. This would not be very cost effective however but would add to the quality and recyclability of the product. Also, the back piece could be made out of one piece of solid wood. I think that this would add sense of quality and 'weight' to the product.
Head		On a larger scale this process would be unsustainable since it is to time consuming an would take up to much space and machinery for to much time. An injection moulding process would be sustainable on a large scale. The dies would need to be made and I need to modify the design to make it easier to fit together and house the electronics.
Electronics		The soldering is quite time consuming but there are not that many parts to connect. However, for commercial manufacture, I would buy in ready made circuits with all of the parts already linked and assembled. I would need to modify the design to run the cables through effortlessly and anchor them in place. The cable could then come out of the back of the lamp and have an external switch for operation



The invention calculator app indicates that 1% of the market opportunity is120,000 lamps. Injection moulding is suitable for large batch runs of 10.000 items plus depending on the size of item to be made.

For the head of the lamp, I would modify the design to be made using injection moulding.



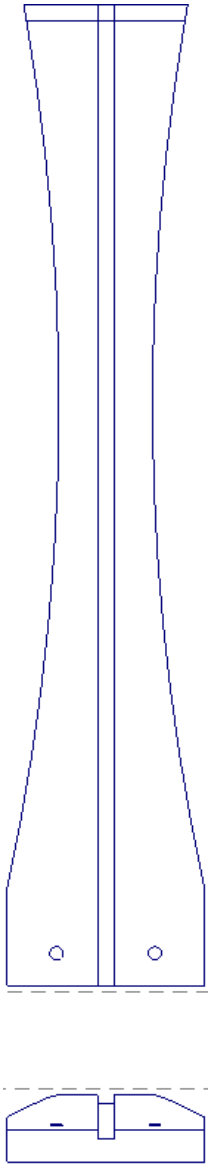
The model (left) shows the lower half of a 3D model of the mould that would be used for the injection moulding process of the top of the "Leaf". Using injection moulding rather than 3D printing saves time and cost during the manufacture. This mould would be part of an array of moulds – up to 24 moulds at a time, which will make the process quicker and more efficient.

I will continue to use ABS for injection moulding in order to retain the properties that I require for creating the top piece. These being that ABS can be coloured using pigments before moulding enhancing the desirability to a wider range of users. It is relatively strong and tough so will withstand everyday wear and tear. It has a melting temperature above that of the heat caused by the LED console. The surface fish can be smooth or textured depending on the quality of the mould and can easily be wiped clean. ABS is recyclable and can be disposed responsibly at the end of the products life.

The head needs to be modified to make it easier and quicker to fit together. This can be done using locating pins. The top half would have ‘male’ pins that fit inside the ‘female’ slots as shown in the diagram. Additionally, the edges can have integrated clips that can hold them both together without the need of glue.

This will make it easier to recycle at the end-of-life of the lamp, or repair if it gets damaged.

The top piece will also have ‘ridges’ that will help the LED strips to be placed and glued in.



To make sure there is a big enough channel for the cable to run through, the commercially made lamp back will have a channel running through the back made by routing on a 4-axis CNC machine. This will be done as pat of the manufacturing process out of solid wood.

I will add a metal effect plastic strip to the back to house the cables and to make sure it is safe. Rather than use metal, which has a high level of electrical conductivity, plastic has been chosen as it is a good electrical insulator.

Note that there is a gap left in the wood at the top and bottom to allow the cables to leave the back area.

The 4 P's

Price

From the user testing, the majority of the group determined that a fair sales price would be approximately £70. From this, I determined that I initially thought that the price would be approximately £60-70.

Looking at similar products on the market, the majority of 'normal' lamps range from £20-£55. However there are luxury, designer lamps available for over £200. The most expensive wooden lamp I could find is £85.

I also need to consider the cost of USB charging points. The Apple 12W charger for the iPad costs £15, with other generic brands costing between £4-12.

Considering the added value that the USB charging points give, I think that a sales price of £70 would be a good target, with an introductory price of £65.

I have used an online calculator to figure out a unit cost of production for the head. This comes out at £0.70 per unit based on a scale of production of 100,000. This includes the cost of making the initial mould.

Shanghai Sourcing

Mold Price (Exchange Rate: 1 USD = 6.2 RMB)

Mold core: 46 X 20 X 10 cm Price: 2392 RMB

Mold frame: 58 X 32 cm Price: 2555 RMB

Other Material Cost (copper electrode,angular pin、injection pin) 2186 RMB
Hot Runner System: 0 RMB

Total Material Cost: 7133 RMB

CNC machining 5992 RMB Electrode machining 957 RMB
Laboring 4000 RMB Wire Cutting 718 RMB

Total Production Cost: 8666 RMB

Mold Design cost 1580 RMB
Mould testing cost 2018 RMB (3 trials)
Factory Overhead and Profit 6400.9 RMB
Tax 4386 RMB

Total Mould Price 30184 RMB or 4868 USD

Product Price

Material Price: 1.85(RMB)
Production Price: 3.21(RMB) Using 300 Ton Molding Machine
Factory overhead and profit: 1.32(RMB)
Tax:0.38(RMB)

Total Unit Price: 6.76 RMB or 1.09 USD

>>Click here for detailed notes.

Source: http://www.sourcing-cn.com/moldcalc_input.asp

I have also priced solid walnut, which comes out at £4.72 per unit. The machining cost estimate is £1.45 per unit.

The circuit, LED strips, switches and USB ports are costed at £1 per unit.

I estimate £1 per unit for the assembly.

The total material and manufacturing cost per unit is £8.90 approx.

Checking the price

Using a common 'rule of thumb' to calculate the retail price of a product (30% manufacturing costs, 40% manufacturing profit, 30% retail profit), I have calculated a price of £29.67.

As this is a premium product that converges USB technology and lighting, and considering advertising costs and when looking at cost similar items on the market, £70 per unit is a fair price.

To incorporate a psychological price point, I would retail the lamp at £69.99.

I also decided to use the Invention calculator to calculate the potential profit.

I based this on the retail price of £69.99.

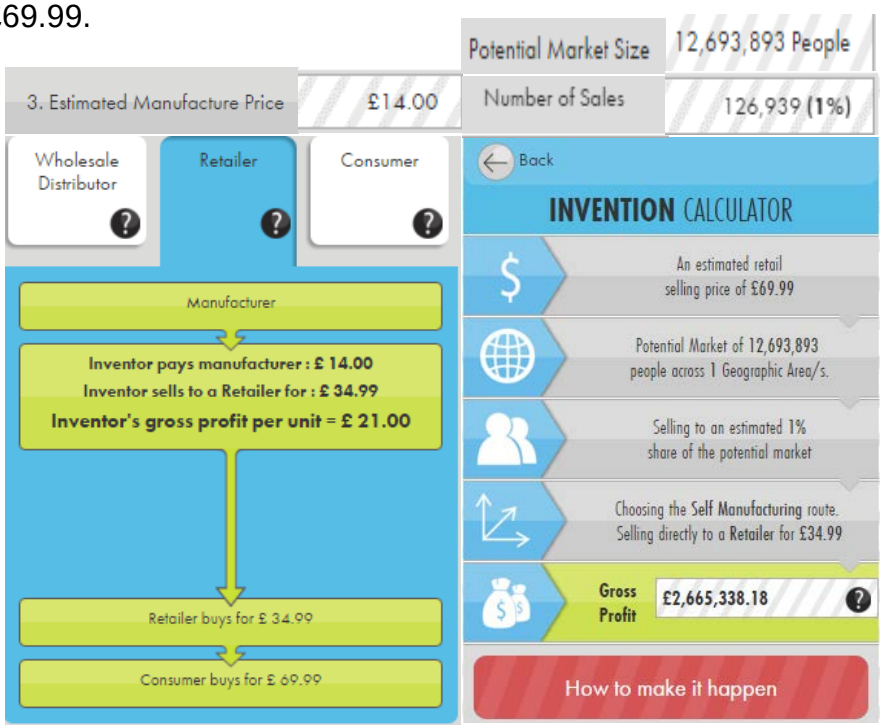
I identified my potential market size using the following constraints:

- country – UK;
- Male and Females;
- ages 18-34.

I based on selling to 1% of the projected market.

I decided to manufacture myself and to sell to retailers as the main strategy to diffuse the lamp into the market.

The calculator estimates a gross profit of over £2.5 Million

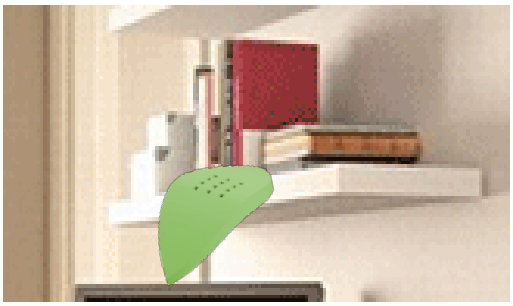


Product

The lamp will be offered for sale on two different levels, there will be a standard product that is made with the green head and the walnut body, but in order to offer a premium service, I will set up a Just-in-time manufacturing process for the lamp head. This way, individual customers can order them in whatever colour/pattern they like and the heads can be 3D printed. This would then be offered as a part of a premium range. With the added production costs involved in 3D printing to order, the retail price would be raised to £84.99.

Also, as part of the premium range, I will offer the lamp in different solid wood materials. Initially, I will offer in Oak and Beech which have come from sustainable forestries. This will create a product family. The heads would come in a choice of autumnal colours. If each one is made of solid wood, they will all be different and each will be a unique product.

This will also lead to limited edition lamps that can be themed. The 3D printer could be used to create different patterns using the same shape head. By keeping the same shape head, the cost of production can be controlled. Limited edition lamps could be marketed at a higher price point that the normal lamps, and this would be around £109.99.



Also, I can use the distinctive shape to expand the range of products and design a range of complimentary floor lamps, wall lamps and ceiling lamps. This will enable the users to create their working space on a single theme, and will bring further contentment to their working life.

Additionally, I could use the head of the lamp to create clip-on versions. The clip-on version could attach to shelves.

Promotion

As part of the promotional strategies, I have used the silhouette of the lamp from the back view to develop the logo to the left. The name of the lamp is the 'Leaf' lamp and this will be part of the advertising campaign. Using this as a brand identity can allow the company to build brand loyalty that will then make it easier to push out new products under the same name.

Place

The lamp is designed primarily for students and young professionals. Therefore, they would need to be sold in stores that the would frequent. This would include furniture stores that are in the mid-price range including Next home, and department stores such as Marks and Spencers. The lamps would also be sold in specialist lighting stores and designer stored. That way the unique product can be made available to a wide section of the market.

The lamp could also be sold in technology stores as it incorporates technology in its design. This is its unique selling point and it is important to advertise this aspect.

Additionally the lamp would be marketed in a similar way to apple products, as a revolutionary concept. I have included a possible advertisement below that projects the coolness of the lamp.

The lamp would also be sold through a website. The website would be similar to Apple's website in that it will include lots of white space.

Promotional Plan

Gain funding and support

- Launch product through Kickstarter. Gather market research and attain additional funding

Introduce product to market

- Sell limited run of 200 products through Groupon at discounted price of £50. Product freely advertised to a wide audience

Increase sales opportunities

- Distribute and sell items through leading retailers such as M&S, John Lewis, Habitat and Next.
- Advertise product in designer magazines such as Wallpaper and ICON. Consider advertorial in national press.

Increase product family

- Add to current products by designing and selling a clip-on and floor standing version of the LEAF.

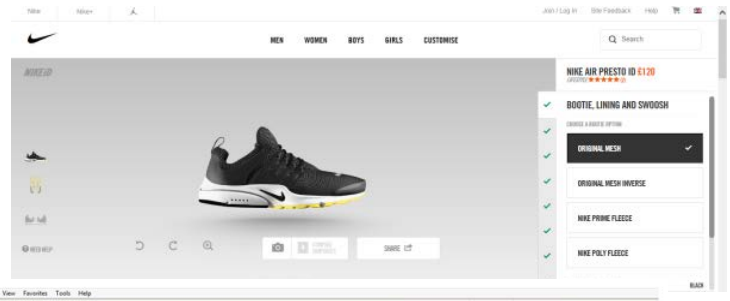
Increase advertising of product family

- Make use of online advertising through social network channels such as Facebook and Google pop-ups.

Mass customization website launched

- Website launched for online sales allowing customers to select materials and colours at an additional cost to standard designs.

On-line customisation tool will be similar to that of NikeID. Allowing visualisation of the product before purchase.



An example of how the lamp would be displayed on the John Lewis website – for illustration only.