A Level
Design and Technology
Insights 2024

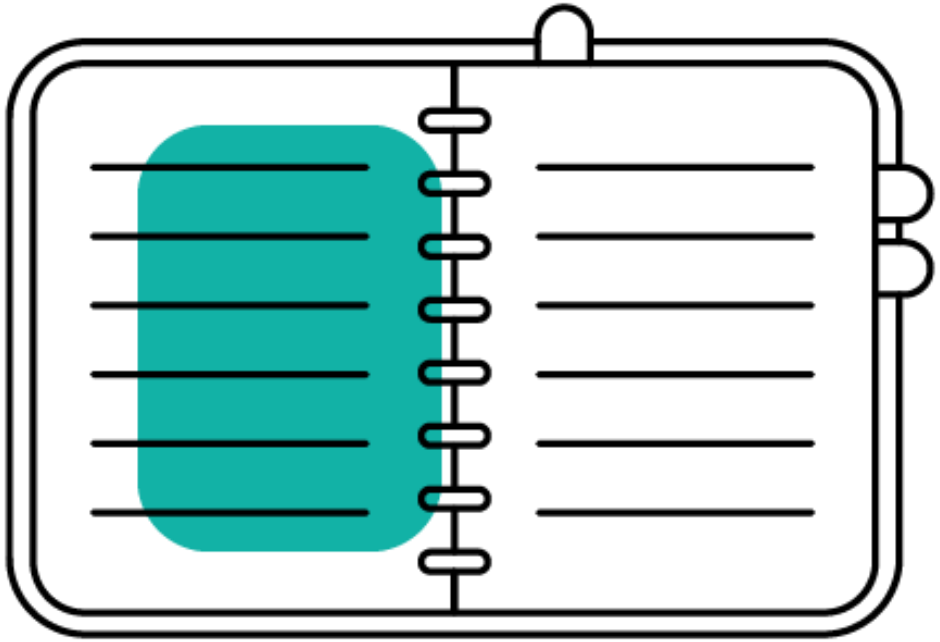
Agenda

Component 1: Examination

- Review the examiner report for the series.
- Highlight key areas of success and common misconceptions.
- Identify questions where students frequently lost marks.

Component 2: NEA

- Provide feedback on the moderation process.
- Focus on areas where candidates have not met the standard.
- Highlight common misconceptions and misunderstandings of the assessment criteria by students and/or teachers.



Pearson
Edexcel

Module One
Written Examination

Reporting for this series

Common exam mistakes:

- Inappropriate response to the demands of the command verb
- Ignoring the constraints posed by the context of the question
- Not responding to mathematics questions with the required degree of accuracy
- Plotting incorrect node/corner points in isometric drawings
- Using the examples from the stem of the question as their answer
- Being confused about the characteristics and philosophies of the design movements

Example Appropriate Response to ‘Explain’

(b) The manufacturer embraces user centred design when developing new products.

User centred design considers user needs, wants and values.

Explain **two** other considerations of user centred design that help to ensure that products are fit for purpose.

(6)

1 User centred design can utilise focus groups drawn from potential stakeholders to gather a range of opinions and useful feedback because this will help the iterative design process and therefore improve the design of the product.

Command Verbs Used

Name

Give

Outline

Explain (two marks)

Explain (three marks)

Calculate

Describe using labelled sketches

Discuss

Draw

Evaluate

Mark Scheme

Any two explanations that include identification of a consideration (1) and linked explanations of that consideration (1) + (1).

1. Intended use of the product is central to the design (1) to ensure the product meets the specification (1) in order to fulfil user requirements in its intended use/environment (1)
2. The functionality of the product / what functions does it need to perform / how the user interacts with the product (1) the product needs to usefully perform to the specified level/use / have appropriate ergonomics / safety (1) in order to be effective in meeting user requirements (1)
3. Is the product innovative/a new approach to addressing a problem (1) by using new methods/materials/technologies/new approaches (1) to improve performance/cost/durability/ease of use (1)
4. Authentic design approach (1) so that all aspects of the design process are valued (1) and the user is the true focus of design (1)
5. Use of focus groups (1) to gather opinions and feedback (1) in order to drive design improvements (1)

Example Inappropriate Response to 'Explain'

(b) The manufacturer embraces user centred design when developing new products.

User centred design considers user needs, wants and values.

Explain **two** other considerations of user centred design that help to ensure that products are fit for purpose.

(6)

1 What function does the product need to perform. Use of focus groups. Is this a new approach to addressing the problem.

Identification from MP2

Identification from MP5

Identification from MP3

Areas of Success

- Examination performance is generally improving with an **increase in the mean score** this year.
- Candidates generally perform well in the **mathematics** questions.
- Candidates generally perform well on the **drawing** question.
- The final evaluation question provides appropriate challenge for candidates across the ability range, allowing candidates of all abilities to perform appropriately.

Poorly Answered Questions

- Question 1(b) reasons for using carbon steel for a chisel blade
- Question 6(d) about the parts of a risk assessment
- Question 9 about innovation management
- Question 10 about the benefits and drawbacks of reactive glass

NEA

Common Issues 2024 Insights

- The use of feedback throughout the portfolio – The iterative question
- Client led proposals
- Irrelevant Research
- Specifications
- Quality of design work
- Modelling and Architectural modelling
- Quality of manufacture

Insight 1: The Iterative question

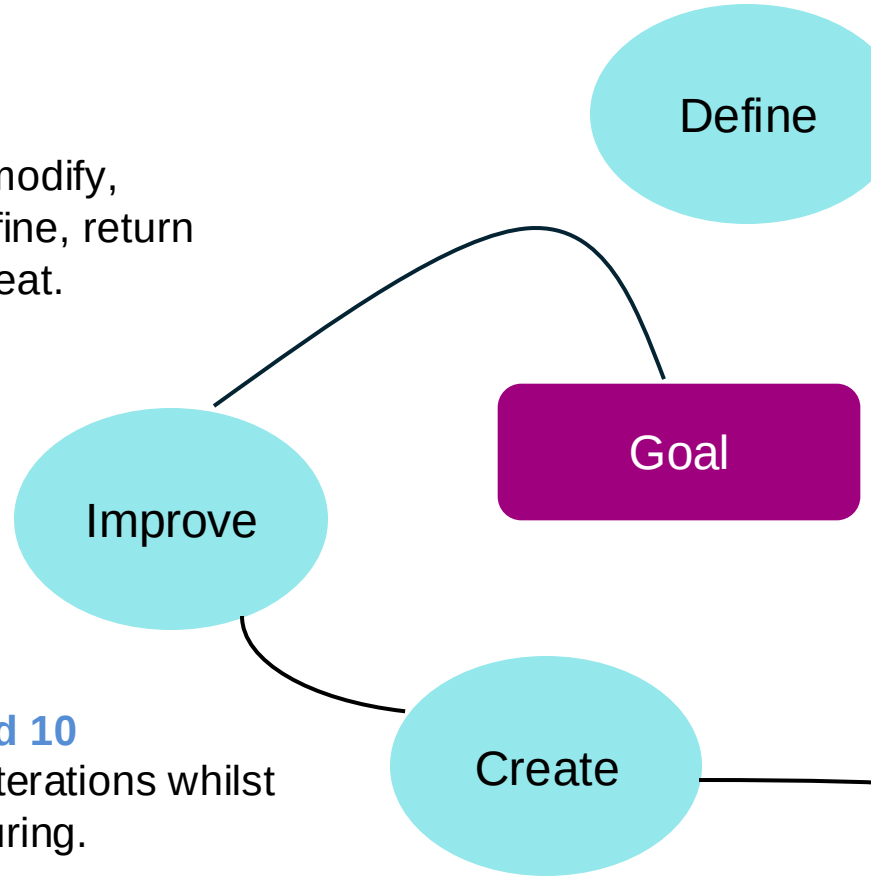
The qualification has at its heart the iterative design process. It is a fundamental objective of the qualification, and it underpinned the call for more rigour, both at GCSE and A level, when the qualifications were redeveloped in 2015/16.

Qualification aims and objectives

The aims and objectives of this qualification are, to enable students to:

- use creativity and imagination when applying iterative design processes to develop and modify designs, and to design and make prototypes that solve real world problems, considering their own and others' needs, wants, aspirations and values

The Iterative portfolio – iterative design process



Grids 1, 2 and 3
Consult client and stakeholders. Trigger iterations.

Grids 4,5 and 6
Client designer relationship. Trigger iterations.

Grid 7
Review may trigger iterations

Grid 6 and 8
Plan and check for potential iterations.

Grid 9 and 10
Potential iterations whilst manufacturing.

Grid 11
Test, evaluate, modify, progressively refine, return to client and repeat.

Insight 2: Client led proposals

Grid One

This is the starting point of the portfolio and is therefore imperative.

Identification of a Design Possibility

- To work in a client centred/iterative way, candidates must identify the problems or needs (possibilities) of a client/user-group to develop a product that may fulfil those needs. The client/user-group could, for example, be a target market opportunity, a local business or organisation, or an individual client.
- Candidates can explore design possibilities, by undertaking market research, conducting identified user group interviews, or responding to a number of identified possibilities and justifying the choice of one.
- We expect that candidates will justify problem starting points from a range of positions. Some candidates will identify a range of problem starting points and others may focus on one and justify it. Working with the client they need to make a decision on the potential design possibility that they will be working on and then produce a preliminary design brief.
- Once candidates have identified the design possibility, they need a comprehensive investigation to identify the key information that needs to be researched to inform the design requirements.

Client led Proposal

Hose Holder exemplar

Introducing the client

Name: Peter Hodgkins
Age: 46
Occupation: Chartered Engineer

Mr. Hodgkins is a teacher at my school. He likes to spend time outside in his garden and likes to spend time with his cat and daughter. When he isn't teaching in the classroom, he goes to his daughter's squash competitions.

The property management market is increasing each day. People buying their first properties and having to fix problems and maintain the property once they have bought it. This is my focus for my product

Beech Leaves

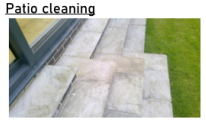
"This part of my garden is always untidy and because there are tall beech hedges next to it, the hedges shed their leaves at the end of spring and it's a big mess. Then they start rotting and clogging up drains and such."
How do you get rid of the leaves?
"Well to be honest I use to big boards like hands to scoop them up but as I get older, I won't be too keen on bending down all the time like that.

Analysis of main problem through discussion with client

I talked with my client about problems in his life that might be helped by a product. He said that he has a lot of bikes in his garage and that his garage is a mess. He also needs some way of safely receiving his mail deliveries without them being stolen. He also has general property maintenance and household maintenance such as cleaning out his gutters and drainpipes, having hoses everywhere and struggling with storing them or moving them easily, cleaning the patio, treating wood, counsel given clippings bin overflows after cutting the bushes, watering plants, cleaning his car, and when cutting the hedges, it is difficult to reach the top of the hedge.

Investigation

Patio cleaning



My client's patio gets dirty over time, and it is a hassle to get out all the proper equipment to clean it.

"It does require regular cleaning, but the problem is that it is next to glazed windows, the cleaning spray splashes on the windows. However, it doesn't get rid of all the algae and lichen. Also, it might damage grout due to high pressure of the water sprayer."

Compost bin

My client has an upright plastic cylindrical compost bin that regularly over fills and isn't as efficient as it could be

"If I put grass clippings into it, it does not compost well unless you turn it over regularly. For a lot of compost bins, stuff just sits there not properly composting because the layers aren't right it's not turned regularly, and bins like this it's difficult to turn without getting all of the compost out. Big open compost bins are handier because you can just take a shovel and turn it. I don't know if there is an option to have a rotating type bin where you don't have to get all of your compost out."

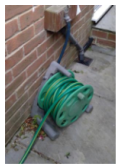
What do you do when your compost bin gets too full of the beech leaves?
" In the green waste collector bins, but they only come every two weeks and during the spring and summer and if you miss the collection you have to wait another fortnight so it's a month between collection, and you have to pay for it.

Design possibilities

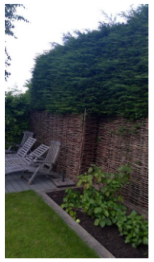
I could make a bike rack organizer that stores the bikes efficiently in the garage and stores anything that the bikes would need e.g., pumps, patches, or attachable lights. I could also make a seat that the mail deliveries can safely go into. I could have a quick way of having the hose be packed away so that it doesn't kink and is easy to take off the mounting system. I could have a compost/ bin attachment so that the bin would be able to store more clippings. The gutter and drainpipes, I could make a tool that effectively cleans them better than the current tool used to clean it or I could make a product that helps with the cleaning of it. With the hedges I could make a product that helps you reach the top of the hedges that is easier to use than current market products

Hose management

My client has a hose reel that is too small and is very inconvenient for his garden.
"There is a hose reel for hose management, but it is really difficult to use. Because it is free standing if you put pressure on the hose then it twists round and jams the reel. If you are trying to wind it up, because its free standing, you have to put quite a lot of pressure to use the wheel to wind it up, it ends up moving all around, and there is simply not room on the drum for the length of hose I have. Also, it drips, and leaks and I trip over it because it is in a narrow area of my garden. It's generally a pain, but it's the best I've got at the moment."



Tall hedges



My client has trouble cutting the hedges due to their size and the un uniform nature of the ground in front of them.
"These are the hedges I have to cut periodically, at least once a year preferably twice, but I don't seem to have the time for it. Getting up high enough to cut and trim the bushes is a bit of a challenge, they must be approaching 4 meters high. "
Have you tried using a ladder to aid you reach the top?
"I do use a ladder, it's not very stable at the bottom. I've got a flower bed and other things in the way, and I usually do it on my own, so I haven't got someone to hold the ladder when I use it.

This candidate has a real focus on the client and talks through lifestyle, refining what the problem is with detailed dialogue that triggers a final proposal. This is a Level 3 performance.

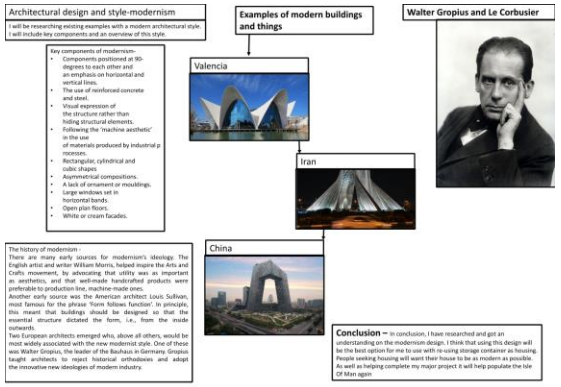
The candidate in this example does have a realistic narrative and identifies areas of potential. Level 2/3 performance.

Irrelevant Research

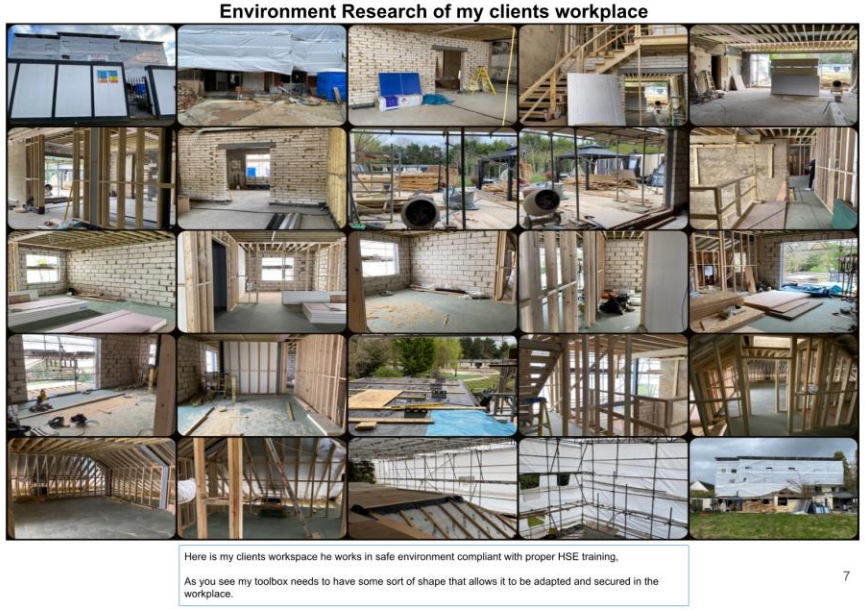
Investigation of needs and research

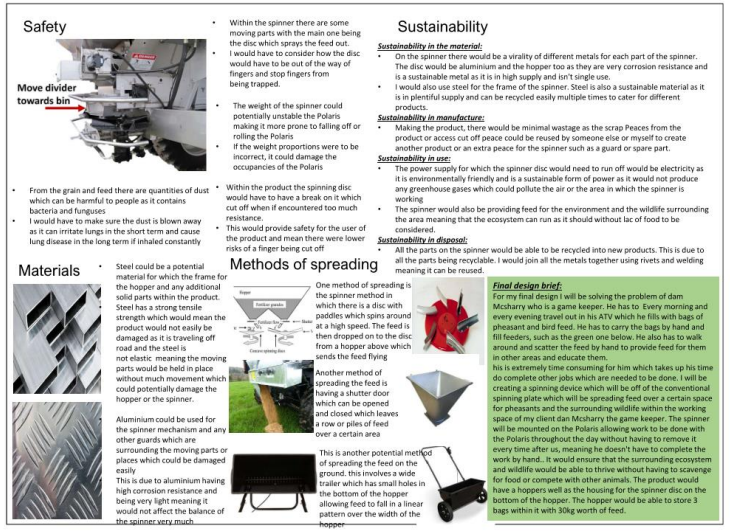
- Candidates should develop their understanding of the needs wants and values of the client/stakeholders
- Undertake relevant and focussed research as a result of a thorough dialogue with client/users/stakeholders
- The candidates will evidence an authentic link between the needs wants and values of the client, and the research undertaken
- The research will be perceptive, as a result of a close designer client relationship
- Candidates must avoid generic research, especially in terms of materials and processes

Insight 3: Rambling Research

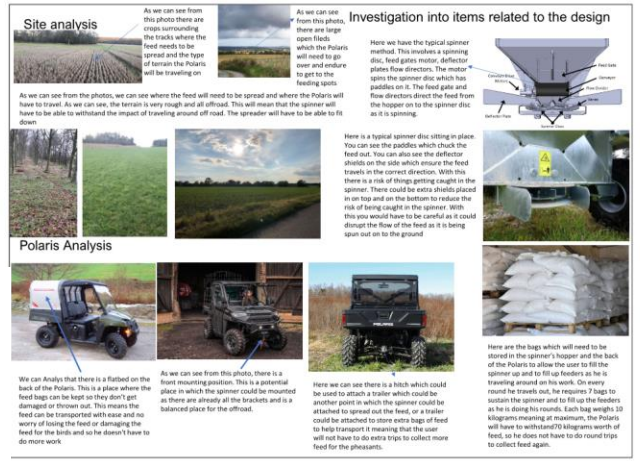


It is somewhat difficult to understand what was learned from these two pieces of research.





Whereas here we see relevant research with client input and focus.



Insight 4: Specifications

The candidates often produced specifications that were generic/descriptive in nature or lacking in technical measurable points.

- A refined design brief and specification must be produced
- At best, these will reflect the research and analysis previously undertaken and consider changes or renegotiations that have taken place between stake holders/client and designer during the research
- This narrative is imperative if the candidate is to fully justify the performance requirements
- The specification must have **technical, measurable** and **realistic** points. The approach should mimic commercial activity
- The candidates would benefit from a test specification methodology

Exemplar Specifications

This is a top-level specification.

This example shows measurable elements here.

Specification: In this section, I will be summarizing and creating a criteria to compare my final product, prototypes and ideas against to create a successful final product. This will branch off from my research analysis.

1. Cost:
1. The budget should not exceed 300USD (tier 3) and an effort will be made to ensure the budget is between $150 to $200 (tier 1,2), as agreed by both clients.
2. A value added calculation (estimation) compared against potential competitors and customer & client response will determine the addition of new parts (to stay in budget). Extra features/parts might be discovered during the design and development process that should be discussed with my clients to weigh up the value.

2. Aesthetics
1. The product must fit in with the surrounding environment to ensure it has a neutral aesthetic and doesn't look out of place.
2. I will follow the qualities of Bauhaus - putting function first then form. As it is a highly functional machine where the focus is on the product.
3. The design of the software must be minimal, spaced and not distracting. I will refer to Jakob Nielsen's heuristics 10 principles of user interface to test the software to ensure it is user friendly, easy to navigate and intuitive.

3. Ergonomics & Anthropometrics:
Design of the Machine:
1. The angle of the screen should be between 30 to 45 degrees from horizontal, to ensure a universal viewing angle that all people can look at, regardless of if they are sitting or standing.
2. An integrated power block/switch must be used to ensure the user can turn on/off the machine and to supply the varying voltages (5V & 12V) to the machine. This must allow for the power lead to be removable if broken or being transported to allow the user to easily repair/transport the RMM.
3. The electronics must be easy to access via a screw-able access panel so it can be unscrewed in the event of a repair - and screwed back on securely for safety to reduce the users access to the mains electric.

Design of the Software:
4. The software of the product must use symbols to allow non English speakers to operate the machine.
5. The software must have a consistent theme and menu system function buttons location to increase operator speed & the usability of the software
6. The screen must be able to be used with gloves (common PPE equipment) in a well lit environment with no flare (to allow the screen to be visible at all angles in case of an emergency).
7. The user must receive some sort of feedback, for confirmation of action execution, and utilize shortcuts to increase the speed of operations.
8. The software must include educational information about each parameter through the use of "i" help icons to allow the RMM to be used independently.
9. The software must include the option to select predefined values for specific molding materials while giving the user full & live control over the machine to appeal to both beginner and expert rotocasters.
10. The interface should only show relevant/essential information. The information should be as accurate (1dp or 2 sf) as required for the user to make a decision. It should be displayed in a simple, understandable form that can be used by the user.

Design of the control panel:
11. The controls should use the "preferred method of control" and the "expected effect must relate to the type of control" to reduce the learning curve of using the control panel. [From page 12]
12. Any buttons used must not be smaller then 16.7mm in diameter to allow users with larger fingers, or gloves on, to easily interact with the controls.

4. Transportation
1. The machine [Packaged] must not exceed 2000mm by 807mm (smallest). To ensure the machine can fit it inside a standard door.
2. The machine should not exceed 17.7 kgf in weight to allow the user to easily pick up the machine and transport it between storage/use.
3. The machine should have a simplified assembly that will allow it to be shipped in a small volume to reduce the overall cost of the machine and environmental impact.

5. Dimensions
1. Should have a minimum mold size of 240mm x 240mm x 240mm.
2. The footprint should not exceed 750mm x 750mm (LxW) (depth of table in Educational workshop + art).
3. The dimensions of the various standard components (Nema 17, potentiometer, etc) will be used in the design of the electronic housing.

6. Safety and Product Testing:
A risk test should firstly be taken of the prototypes/final product and an effort should be made to reduce the overall risk. When designing the product, the following safety standards will be taken into consideration:
1. ISO 12100:2010 Safety of machinery – Risk assessment and risk reduction
2. BS EN 5008 - Product Labeling and Electrical Requirements
3. ISO 14120:2015 - Safety of machinery
4. ISO 13854, Safety of machinery – Minimum gaps to avoid crushing of parts of the human body.
5. ISO 11429, Ergonomics – System of auditory and visual danger and information signals. The labels and signals used to display errors/danger should surpass ISO 11429.
6. ISO 13850:2006: Safety of machinery – Emergency stop.

7. Social, Cultural and Environmental Impact - Page 12:
1. An effort should be made to reduce the power usage of the machine when molding to reduce the effect it has on the environment.
2. An effort will be made to allow the machine to mold renewable materials such as wasted 3d prints [Tier 3].
3. The machine must be able to be easily repaired & maintained and should use accessible standard components to extend the product life.
4. The machine must be able to be flat packed and shipped to decrease the carbon footprint of the product as less units can be shipped with less fuel.

8. Material Properties:
1. When choosing the material for the body of the RMM, I will make sure the material has the follow properties:
   - Can be easily accessed in the workshop and not exceed the material budget.
   - Light weight - reduce the torque needed to turn the inner cores & stress on shafts.
   - Easy to machine/work with - The material should be able to be used in the workshop, with workshop tools.
   - Stiff & hard- should not deform under the weight of the mold & temperature [tier 3].
   - Strong in compression (to hold its own weight and he weight of the mold) and in tensile force (to ensure the material does not fracture or stretch under the load of the mold).
2. When choosing the material for the axles of the RMM, I will make sure the material has the following properties:
   - Can be easily accessed in the workshop and not exceed the material budget.
   - Rigid & stiff - to ensure the shaft does not bend and can support the weight of the mold + axis
   - High strength-to-weight ratio - the lighter a component is the less torque/stress applied to the machine, gears and motors.
   - Easy to machine and work with - should be able to be used on the lathe or other machines used in the workshop.
3. When choosing the material for any gears for the RMM, I will make sure the material has the follow properties:
   - Can be easily accessed in the workshop and not exceed the material budget.
   - Tough - to withstand the grinding force of the opposing gear.
   - Low coefficient of friction - to reduce wasted energy and allow the cores to spin with ease.
   - Good resistance wear - The more durable the gears are, the longer the machine can function for.
   - High strength-to-weight ratio - the lighter a component is the less torque/stress applied to the machine, gears and motors.
   - High tensile strength - allows heavier molds to be used, as motors can turn with a higher torque and the gears will not fracture.

9. Capacity:
1. Below is a list of components that must be included in the final product:
   - [Tier 1] Bearings must be used between shafts and the carcass; Shafts; either Toothed Belt with a Driver Pulley GT2 and/or Bevel Gears
   - [Tier 2] Nema 17 with either A4988 or L298; a 120mm PC fan; a TFT 1.8 inch for output; Potentiometer + Button for input; ON/OFF switch + Emergency stop; 12 Volt Power Supply & a Lead for a house hold wall socket; Arduino UNO/Mega and 100UF Capacitors
   - [Tier 3] Either a heat gun or Induction heater as the heating element, a 120mm PC fan for cooling and relays for control of mains voltage components.

10. Function & Machine (CONSUMER WANTS, NEEDS & VALUES):
10A. Primary Function of the Machine - Rotary mold hollow parts
1. The user must be able to easily fit, and center, a variety of molds into the machine.
2. The user must be able to, by themselves, navigate through the menu systems to get to various molding parameters, information pages and settings to have full control over the machine [Tier 2]. This includes:
   - X axis speed, Y axis speed, X & Y spin ratio, Molding time
   - [Tier 3] Heating temperature, Heating cycle time, Cooling cycle time
3. The user must be able to cold cast repeatable hollow parts [& polymer parts in Tier 3]. [Page 11 - Performance]
4. The machine must be able to reach and maintain a min & max speed of 2 to 20 RPM for 10 minutes to 8 hours to allow users to cast a variety of materials and use varying ratios. [Page 11 - Performance]
5. The machine must be able to use one or multiple ratios when molding to allow users to cast a variety of shapes.[Page 11 - Performance]
6. [Tier 3] The machine must be able to heat up the polymer granules in the mold and rotary cast at a consistent temperature of (minimum) 160˚C
7. The machine must be able to offer predefined values for common molding materials (plaster, easy flow 120, 2 part resin) to allows less experienced users to cast. The values, however, should be able to be changed for more experienced casters..
8. The mounting system must accommodate for both steel/metal molds, ceramic/resin molds and vacuum formed polymer molds to suffice for all mold creation techniques.

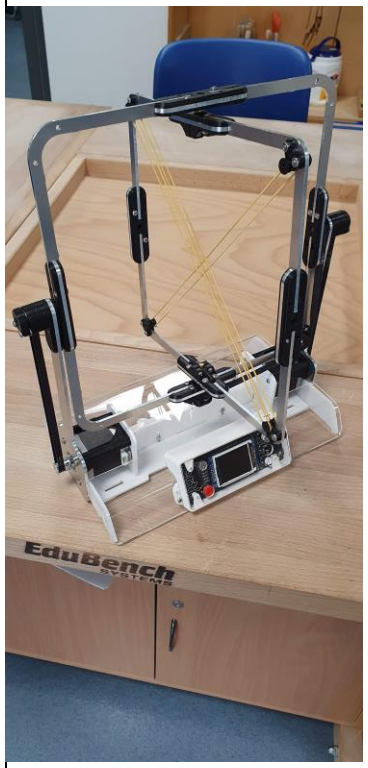
10B. Secondary Function of the Machine - Educational device
1. The user, in their time interacting with the product, must be educated about Rotary Molding and what the various parameters are and how they relate to the mold produced to allow the user to
2. They must be able to adequately use the machine to transform raw material into a hollow part - on their own in a safe manner.

Client Comments: [ART] Overall I'm pleased with the direction the product is taking - I'm glad there is a great focus on making the product intuitive and user friendly. [EDUCATOR] I am glad that Jack has included tier 2 & 3 spec points. However, I would like to see a greater emphasis on safe use of the machine and the educational value gained.

Developed Design Brief: I'm going to design and manufacture an RMM for the educational market, initially focused on D&T & ART teachers, capable of moulding cold resins, foodstuffs, plaster of Paris. It is to be part self-assembled by the user, to be sold at a cost of no more than 200 USD which must be capable of moulding for 1 minute to 8 hours with a rotational speed variation of 2 to 20 RPM with infinite options of variable cycle ratios. It must conform to current BSI standards with an intuitive user interface and preselected moulding menus that can be fully customised by the user.

More measurable elements here for example.

Here we see a re-worked brief, which draws on the research and client requirements.



The candidate looked at design styles and discussed this with the client, in the research section. They looked at the Deco style and a link to 'Smokey Jazz', including the styling and fashion. The discussion led to a high-quality specification point.

SPEC POINT

The proposal should develop the Deco theme and its connection to 1920's Jazz, measurable against other designs of this period.

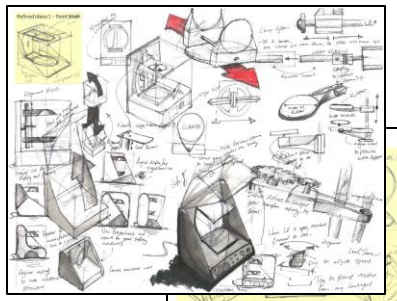
SHOWS THOUGHTFUL USE OF THE RESEARCH, A DISCUSSION WITH THE CLIENT AND A MEASURABLE OUTCOME.

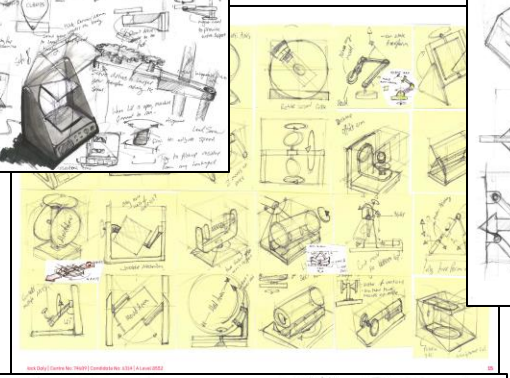
Insight 5: Quality of Design Work

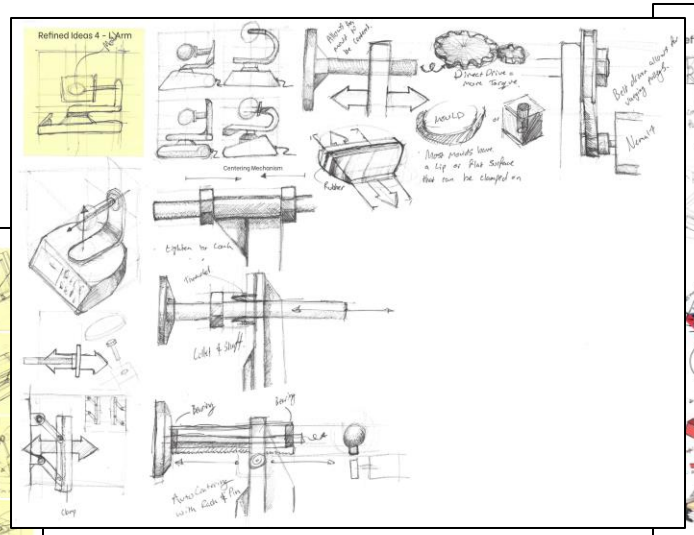
Design Ideas

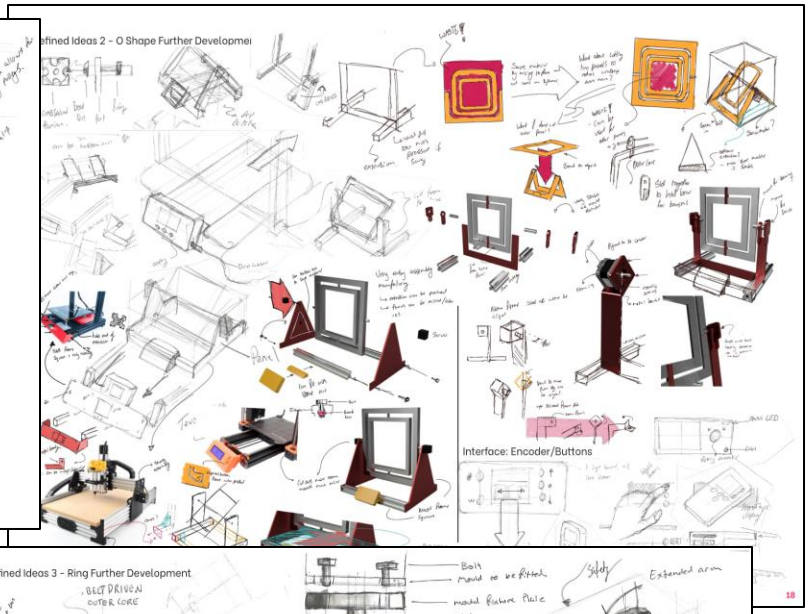
- In this section it is expected that a range of design strategies are used to produce a range of design ideas, that address the specification criteria from the previous section.
- Design strategies include drawn elements such as 2D, 3D, and subsystem details. Other strategies might include inspiration materials, work of other designers and cultural/historical influences where relevant.
- Candidates should be thinking like a commercial designer and apply their knowledge of technical skills and materials and back it up with the research they have carried out previously, plus any additional research that is required.
- It should be obvious that the work has considered the needs established prior to this section.
- Annotation should illustrate the candidate's knowledge and understanding of technical elements such as materials, processes and techniques that are relevant to the identified design area.
- Iteration should/could occur in this section – and beyond (you may see linear or cyclical designing.) However, the client/stakeholder input should be apparent.

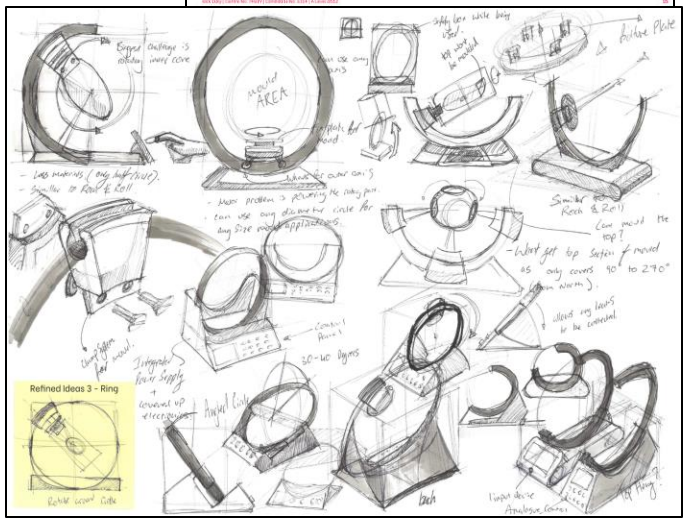
Insight 5

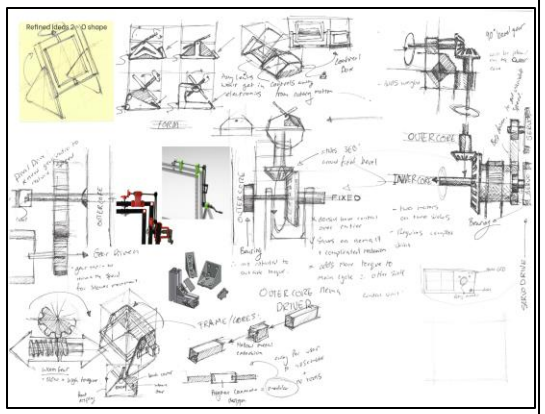


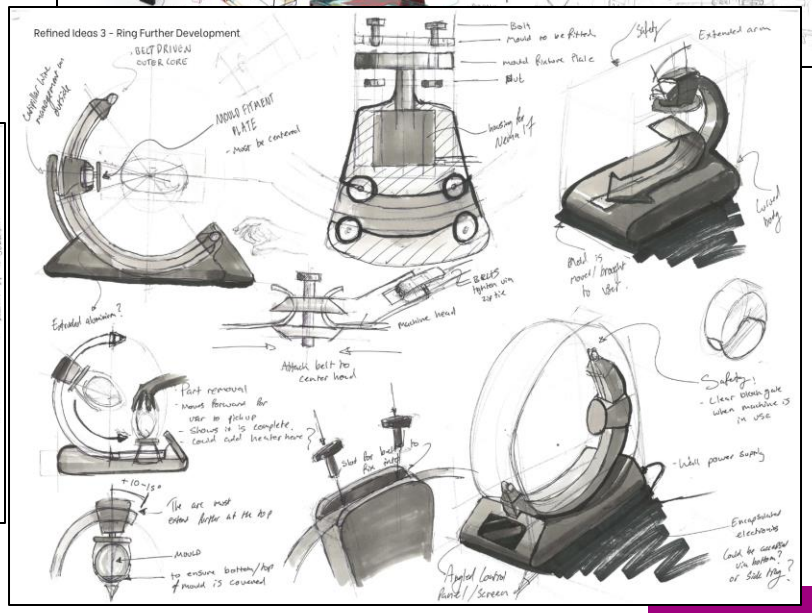












This is a superb example of fluid design work. The candidate has a sketching style that exudes confidence. The annotation shows a knowledgeable grasp of the important theoretical elements that are relevant to the design sketches. This is a top-level example of this assessment criterion.

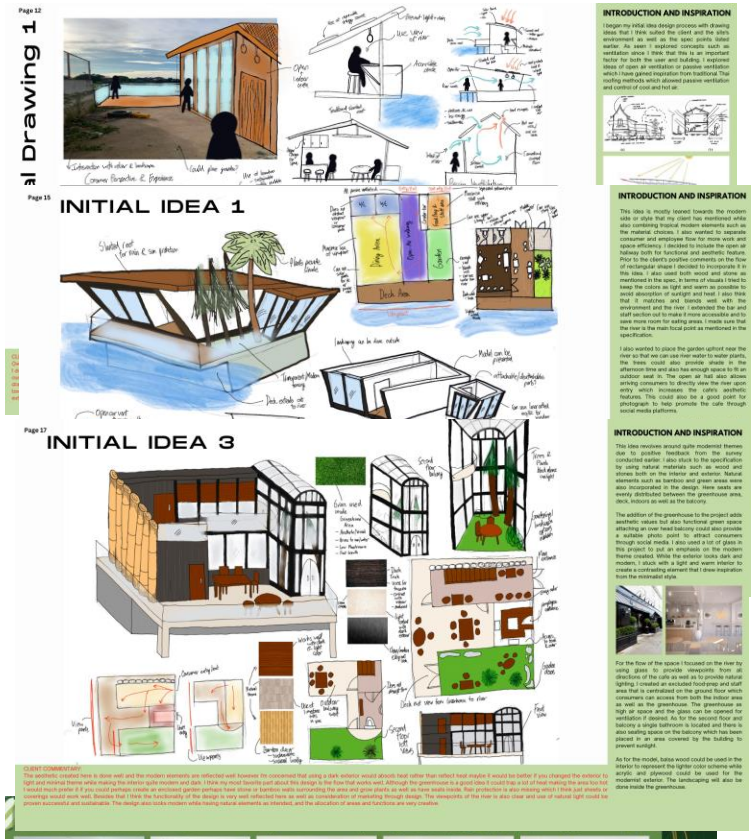
Insight 6: Modelling and Architectural Modelling

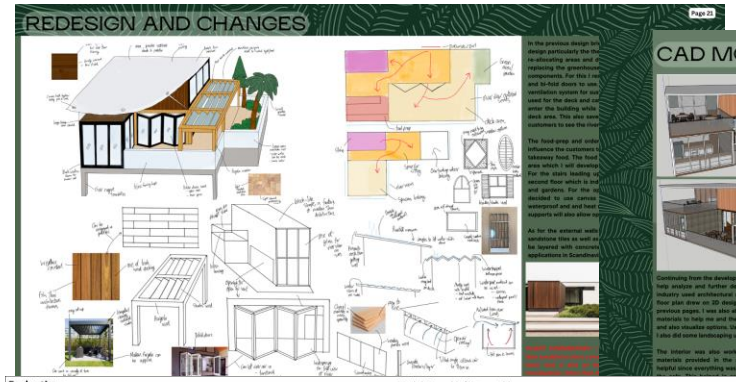
Concept Modelling and Architectural modelling is an acceptable approach to use as a submission

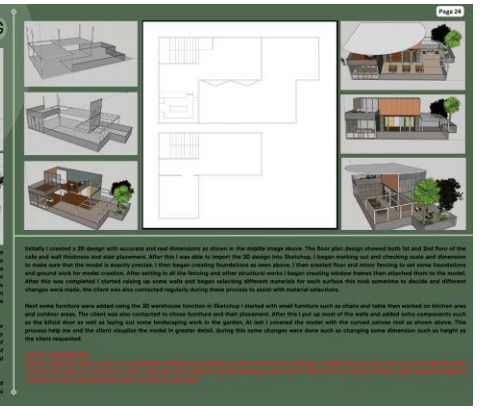
However, these rules apply to both:

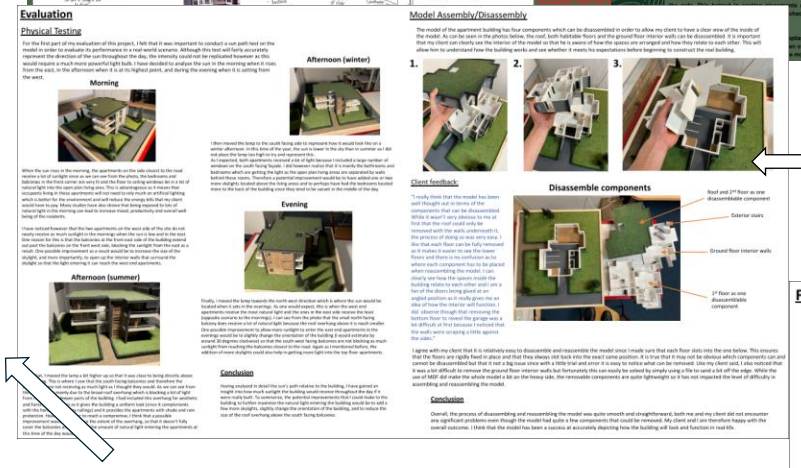
- The models must be produced accurately and to scale
- They must use an appropriate selection/range of materials, fixtures, components and fittings
- They must use a range of skilful, accomplished making skills/processes
- They should display A level demand and rigor

Extracts from the work of Candidates who scored highly when taking an architectural approach









Candidate shows evidence of good evaluative commentary and well-made final model.

Candidate shows a good range of ideas and evidence of some sub-systems design

Insight 7: Quality of Manufacture Tools and Equipment

This assessment criterion can produce polarised outcomes, with very good performances at one end, or a lack of demanding A level processes at the other. Where candidates had modelled products, they were often at a low level, and on occasion, relied heavily on a CAM output, with limited interlocking parts. That said good quality modelling can allow access to the higher mark levels.

Positive

- ✓ Candidates should undertake real client dialogue
- ✓ Candidates should utilise demanding A level skills
- ✓ Candidates should select processes and tools that show sound technical understanding that are relevant to the design proposal

Negative

- × Candidates should be advised against submitting simplistic outcomes, using limited skills and processes
- × Candidates should aim to avoid work wholly CAM produced without complexity

Insight 7: Quality of Manufacture Quality and Accuracy

This section should be characterised by demonstrating high level making skills that evidence accuracy, leading to a quality artefact, that is a fully functioning prototype that meets the end user needs, identified in the specification. We should also see candidates being confident enough to consult with the interested parties and amend the design during the manufacturing as a result of this consultation, or indeed in response to issues during the manufacturing process, therefore evidencing an iterative approach during making.

Positive

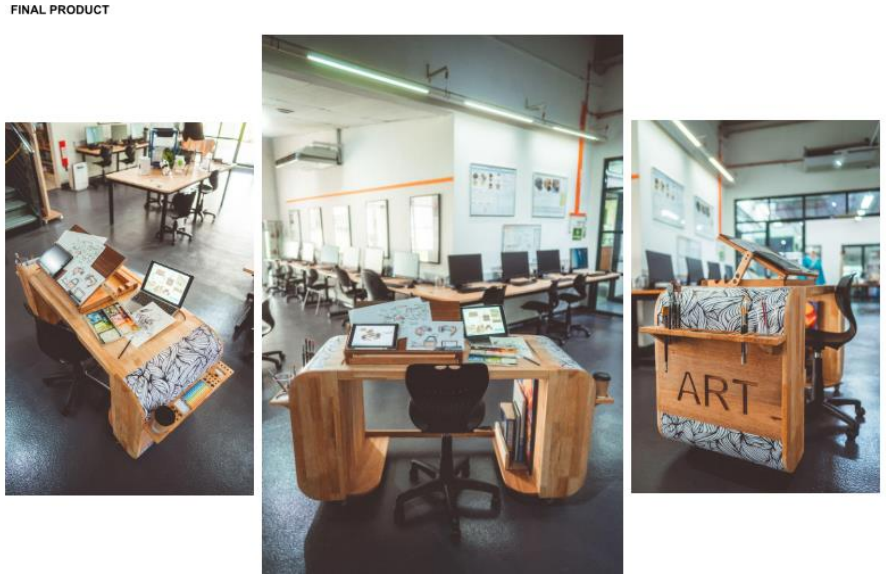
- ✓ Candidates should undertake real client dialogue, illustrate an iterative process.
- ✓ Candidates should undertake A level demanding manufacturing techniques and making skills.
- ✓ Candidates should produce an accurate prototype that is well executed and finished.

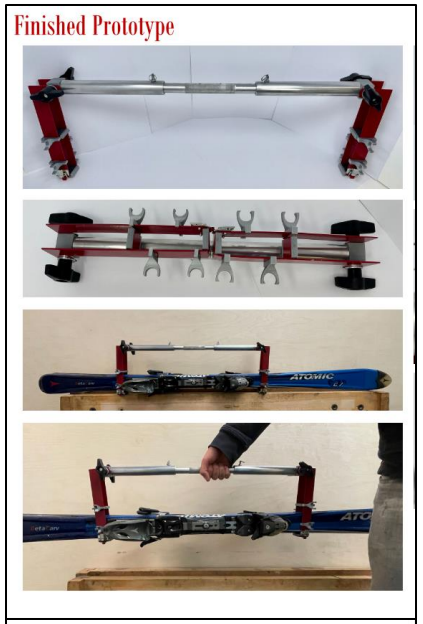
Negative

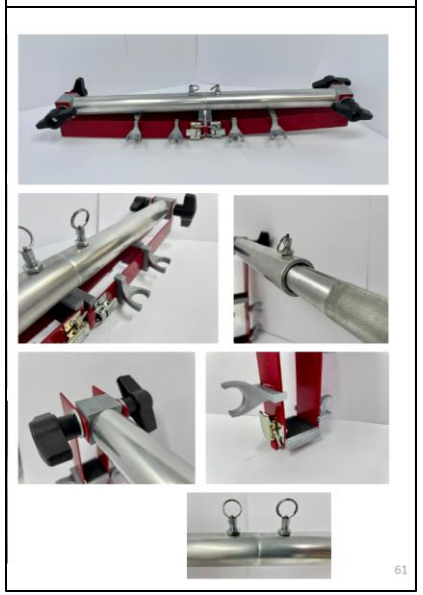
- × Candidates should avoid submitting simple outcomes.
- × Candidates should avoid submitting inaccurate scale models

Insight 7: Quality of Manufacture

A range of high-quality products.







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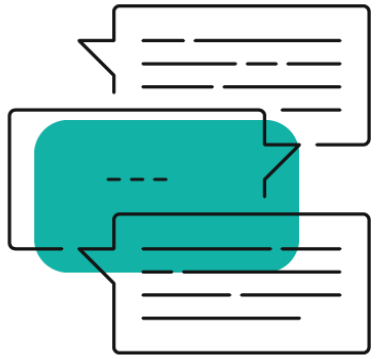

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