Deliverable E

GNG1103 B005

November 3rd, 2023

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Abstract:

This report provides a comprehensive overview of key project components, starting with a focus on materials and cost management. It emphasizes the importance of gaining cost approvals and maintaining financial estimates, including temporary materials for prototyping. Additionally, the report highlights realistic and justified material and part costs, demonstrating a creative approach to cost management. It also stresses the necessity of selecting the right tools and components based on clear cost-benefit analysis. The report seamlessly integrates these steps into the broader context of project financial management. It then addresses risk assessment and contingency planning based on the work completed to date, taking dependencies into account. Building on this foundation, the report guides the creation of a detailed plan, considering prototype limitations and functional overlaps with the final product. The report also underscores the significance of effective communication, feasibility verification, and defining stopping criteria for testing objectives. Clarity in defining what to measure and acceptable fidelity based on prototype goals is a core focus. In summary, this report offers a systematic approach to project development, ensuring thorough planning and testing.

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1 Introduction

The process from conceptualization to realization is a multifaceted process that demands careful planning and execution. This report serves as a guiding compass through a critical juncture in the project's development – the detailed design phase. This phase involves the intricate articulation of the chosen concept, taking into account each essential component, from fasteners and adhesives to wires and power supplies. Furthermore, it sets the stage for prudent financial management, underscoring the importance of cost approvals and the creation of a comprehensive Bill of Materials (BOM), which estimates the financial requirements of all project elements, including temporary materials used exclusively during the initial prototyping phases. Additionally, this report emphasizes the selection of appropriate software and hardware, risk management, and the formulation of contingency plans to ensure the project's adaptability in the face of potential challenges.

2 Detailed Design Drawing

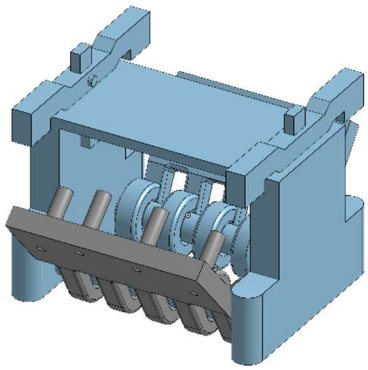

Figure 1.1 Jig Design

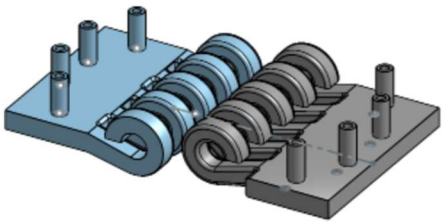

Figure 1.3 Plate Design Presets

The decided solution combines all requirements set by the client into a single and effective design. Firstly, to allow the system to switch between presets the decided solution is reversible. One side has all the requirements for the 4.5 by 5-inch hinge while the other side has the requirements of the 4.5 by 4.5-inch hinge. To ensure that the presets do not interfere with one another, a hinged edge permits the preset not in use to be moved out of the way. The combined depth-levelling system will include thickened plates that fit snuggly into the pre-routed holes. These plates will have stop collars around the holes which will stop the drill once it has reached the desired depth. Additionally, the collar's depth and the guide ensure that the drill remains straight and perpendicular. Only a straight drill would be able to properly insert into the holes and drill into the door. Lastly, the support system relies on double-sided one-hand spring clamps. These can be manually and quickly adjusted to the desired strength using a button, and they support the hinge well no matter which side is being used. The lower support paddles provide the opposing force. Furthermore, to prevent the plate in use from falling over and to facilitate storage, small magnetic knobs hold the plates in the upright position. Padding is also present on the clamps so that the veneer on the door is not damaged. The one-hand clamps also allow faster attachment. The added attachments, while sturdy, make the jig flimsier and potentially more difficult to store.

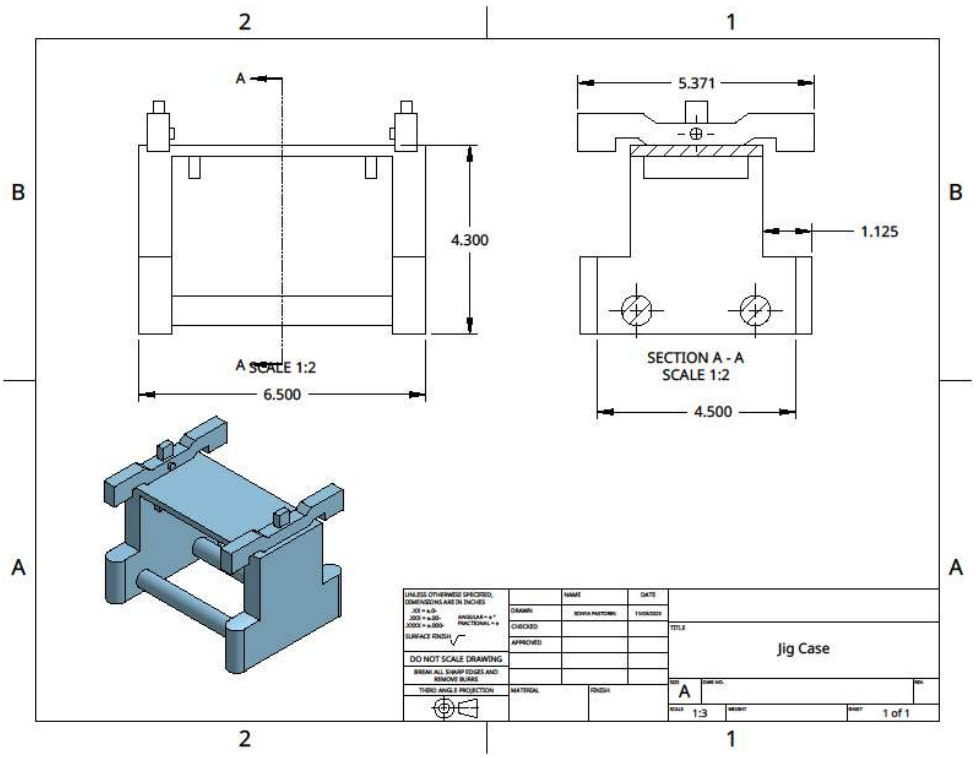

Figure 1.2 Jig Casing (Link: https://cad.onshape.com/documents/8e169d316bec5d98efb29e03/w/5d28341048e91c8399ee1bad/e/e34842b414d52343ba351e1d)

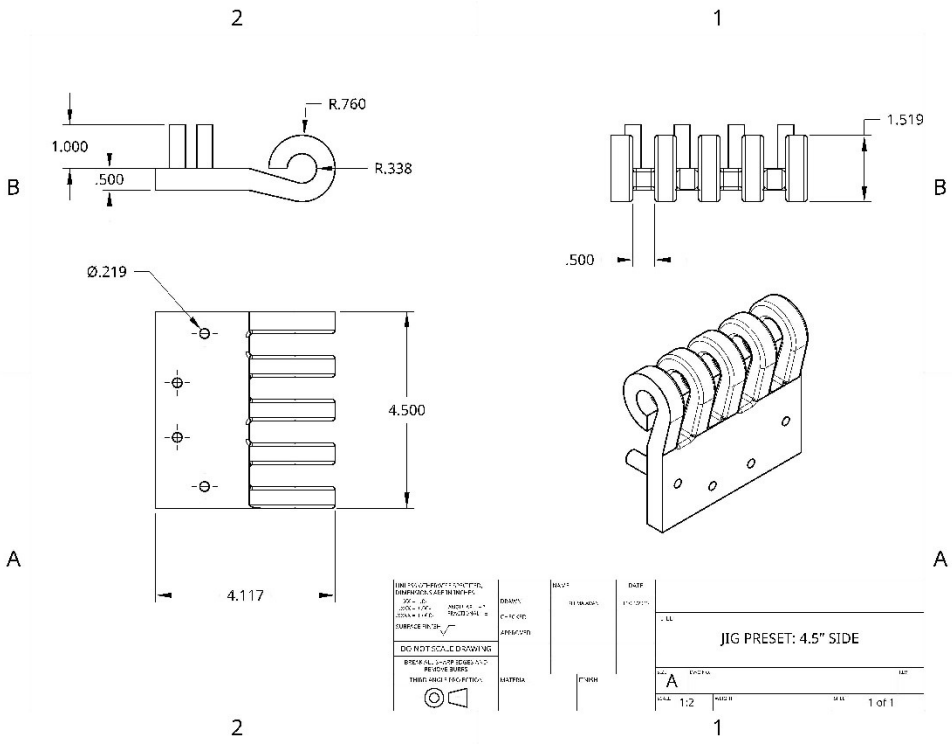

Figure 1.4 Hinge Jig Preset: 4.5" Side (Link: https://cad.onshape.com/documents/0bbb6f90d4a38cba969a09ac/w/df7de3dfc6c4c75b0da29f80/e/3e7b5bf6e511a4c38dd9e82a)

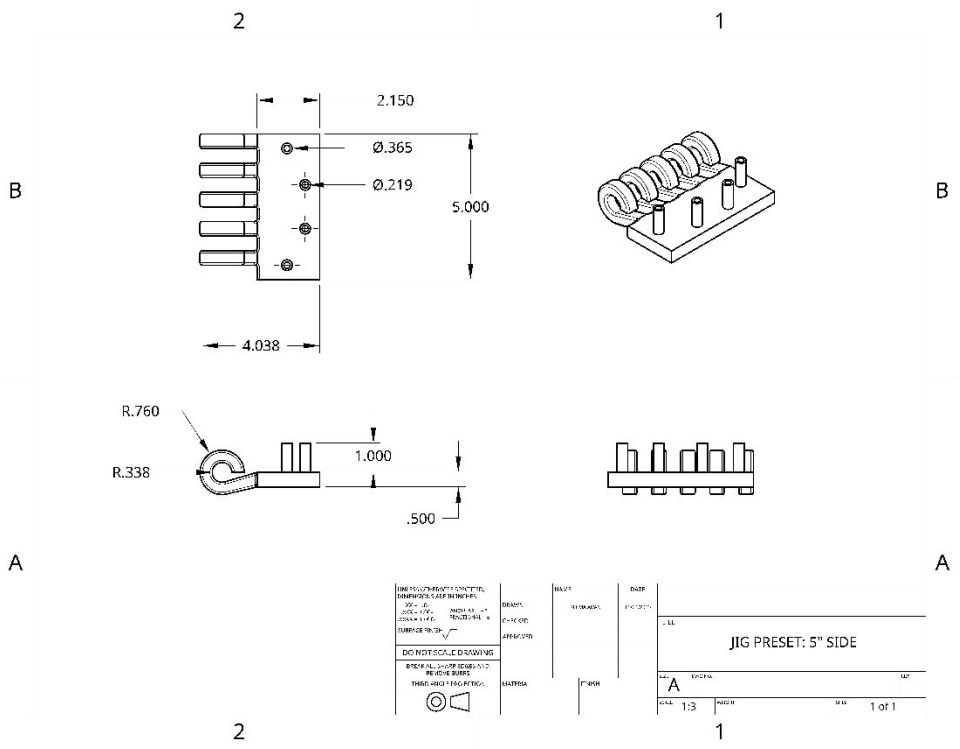

Figure 1.5 Hinge Jig Preset: 5" Side (link: https://cad.onshape.com/documents/0bbb6f90d4a38cba969a09ac/w/df7de3dfc6c4c75b0da29f80/e/0908335695f9db8a4ce21faa)

3 Materials and Cost (incl prototype materials)

There are many factors that must be considered to certify that the final jig will be durable, accurate, and low cost. To ensure that our product will meet Ambico's needs, a table was constructed outlining the both the functional and nonfunctional requirements of the jig, and constraints set by the customer. This table demonstrates

Table 1: Engineering Design Specifications

Design specifications	Relation(<,>, =)	Value	Units	Verification Methods
Functional				
Select materials that ensure the jig's longevity, aligning with the durability requirement	=	Yes	N/A	Performance testing
Quick set-up time and quick time for completion of the task	<	20	Time (mins)	Analysis, test
Provide swappable preset options for different screw and hinge types	=	Yes	N/A	Analysis, test
Ensure careful and padded attachment to the frame, so as to not damage wood veneer.	=	Yes	N/A	Analysis, test

Minimize human error by incorporating accuracy and precision mechanisms into the system.	<	1/32	in	Test
Support system offers independent stability that prevents movement during marking and drilling	=	Yes	N/A	Analysis, test
Integrate a levelling system that guarantees the jig maintains perpendicularity to the floor	=	Yes	N/A	Analysis, test
Guide for marking of holes and back-set	=	Yes	N/A	Analysis, test
Drilling Guide	=	Yes	N/A	Analysis, test
Implement a signaling system within the jig to indicate when to stop drilling	=	3/16	Depth (in)	Test
Constraints				
Cost	<	100	$USD	Estimate, final check
Weight of jig	<	5	(lb)	Analysis
Must integrate seamlessly into the current manufacturing process, considering size and support systems	=	Yes	N/A	Test
Practicality for laborer	=	Yes	N/A	Test
Operation Environment: dust	=	Yes	N/A	Test
Non-Functional Requirements				
easily transported throughout the shop, or can be kept on person	=	Yes	N/A	Test
Incorporate features for convenient handling and support, in line with the strong multi-use support system requirement.	=	Yes	N/A	Test
Reliability	=	Yes	N/A	Test

3.1 Prototype 1

Prototype 1 will be the first physical design of this product. To keep costs low and ensure the focus remains on the product itself it will be built from cardboard. Cardboard is a sturdy and low-cost material that can be manipulated in numerous ways to create a fully functional and scale model of our product. The use of hot glue will be effective at attaching all pieces together. No money will be spent on any of the materials for the building of prototype 1. As outlined in the table below, the schedule suggests a 4 day build period and a 2-day testing period. Understanding that this is the first time a prototype of this nature will be built for our product, we may need to adjust our testing plan to accommodate a longer build period. This should not impact the final design as the initial prototype is more of a proof of concept than something the public will test.

3.2 Prototype 2

Prototype 2 will be designed by solving any functional errors that may arise in the build of prototype 1. In order to effectively demonstrate the jigs function while testing, this prototype will be built from a mixture of 3D printing and laser-cut components. The schedule allows for a much

longer testing period to accommodate the schedules of those asked to test our product. Unfortunately allowing for more in-depth testing of this product tightens the timeline for the final report. To counter this, we will be taking more care in recording feedback and findings as we move through the testing process.

3.3 Prototype 3 (Final Design)

In the final design, Steel was chosen as the main component of the design primarily due to its availability as well as for its ability to be easily manipulated. In fact, the selected steel sheet material is easily flame cut, formed, welded, drilled and machined. Stainless steel is also ideal for the client's working environment, considering its durability as well as its current pervasiveness at Ambico.

In regard to the anti-scratch cushioning on the clamp portion of the jig, cork was selected. Primarily due to it's compressibility, elasticity and flexibility as well as durability, stability and rigidity. These qualities will ensure the solution is feasible for a industrial environment, without compromising it's cushioning ability. Cork also exhibits a suctioning effect, promoting a high coefficient of friction, securing the clamping. This material is light.

The jig is to be fashioned from a combination of pre-made parts and materials to be fashioned by the design team, depending on the simplicity of design as well as cost analysis. Specific information on parts and materials selection is detailed in the following table.

Table 3: Build Specifications

Item name	Description	Quantity	Unit cost	Extended cost	Explanation
Straight Ejector Pins	13mm Dia 65Mn Steel Round Tip Punch 150 Length	1	12.99	12.99	-Pin punch is long, straight, with non-chipping surface, and has a round tip. Not easy to be bent or deformed when working. .-Made of 65Mn manganese steel with quenched and tempered surface treatment and HRC: 48-52rc. This ejecting pin punch has the characteristics of high elastic limit, high strength, high harden-ability and good machinability. -Suitable for working in high temperature operating environment. Applied in fitter, die manufacturing, leather crafting, machinery maintenance and processing industries.
Depth-Limiting Stop Collar	for 7/32" Size Drill Bit	8	3.51	28.08	-Ensures identical hole depths every time. Position the collar on bit and tighten the set screw. (see link for solidworks); steel

Plain Steel Plate	12 x 12 x 3/16 in. 44W	1	24.99	24.99	-This steel sheet is often used for general-purpose fabricating and machining jobs.; matching hinge backset -Ideal for general-purpose fabricating and machining, such as building home appliances, metal furniture, sheds and more.
Cork roll	Concept SGA Mini Cork Roll - 12" x 24" x 1/16"	1	11.99	11.99	-Thin sheet of cork for household projects

Total cost is 66.06$ CAD before taxes.

4 Prototype Testing Plan

The following outlines a schedule for the completion of each individual prototype, as well as scheduling time to collect public opinion, review, and report on each iteration of this product. The schedule below allows for a 24-hour margin of error between expected completion of the final report, and the due date.

Table 2: Prototype 1 + Deliverable F

Oct 29	Oct 30	Oct 31	Nov 1	Nov 2	Nov 3	Nov 4	Nov 5
					Deliverable E DUE		
Build prototype 1 (P1) initial cardboard prototype							
				Test, record, and report on P1			
					Meet to discuss changes to P1 for P2		
						Write formal report on P1 incl. Changes for P2 and why	
							Deliverable F DUE

Table 3: Prototype 2 + Deliverable G

Nov 6	Nov 7	Nov 8	Nov 9	Nov 10	Nov 11	Nov 12
Build prototype 2 (P2) based on observed complications with prototype 1 (P1)						
			Test, record, and report on P2 and the changes			
					Meet to review public opinion and draft final changes	
					Write formal report on P2	
						Deliverable G DUE

Table 4: Prototype 3 + Deliverable H

Nov 13 – 19	Nov 20	Nov 21	Nov 22	Nov 23	Nov 24	Nov 25	Nov 26
Create final prototype							

	Test, record, and report on P3 (his timeline allows time to fix last minute issues.)						
				Write final report P1, P2, P3, changes, public opinion, justify final decisions, etc.			
							Deliverable H DUE

5 Project Risks, Dependencies and Contingency Plans

The path from conceptualization to project realization harbors potential risks and uncertainties that require meticulous consideration and the formulation of effective contingencies. One significant risk in this deliverable was the reliance on the completion of Computer-Aided Design (CAD) work for the precise estimation of material costs. The project's financial planning is heavily dependent on this aspect, and any delays or setbacks in CAD completion could have disrupted the project timeline. This risk is further underscored by the need to ensure that the selected materials align with the project's longevity requirement. This is where the prototype testing plan proves invaluable. Allocating time for prototype testing post-CAD phase allows for the early identification of material-related issues. For instance, Prototype 2, potentially constructed using 3D printing and laser-cut components, permits a more extensive testing period to accommodate the schedules of those testing the product, ensuring prompt resolution of material-related issues and minimizing potential setbacks. This comprehensive testing approach serves as a vital contingency, enabling the identification and resolution of material-related problems before they escalate and disrupt the project's financial planning.

Another risk to consider is the potential for design complications during the prototype stages, especially during the transition from Prototype 1 to Prototype 2. Given the innovative nature of this project, unforeseen design challenges may surface during the development of the second prototype. To address this risk, the project team has implemented a contingency plan, marked by a rigorous prototype testing schedule. Prototype 1, initially constructed as a cardboard model, primarily serves to establish a proof of concept and identify early design complications. The extended testing period for Prototype 2, involving 3D printing and laser-cut components, allows ample time for addressing design issues and fine-tuning the prototype to minimize potential setbacks. This meticulous testing strategy ensures that any design-related risks are effectively managed, reducing the likelihood of disruptions during the project's development.

Furthermore, there is a risk associated with the integration of software and hardware components for the final design. Incompatibilities or unforeseen technical challenges might emerge during the software-hardware integration phase, potentially leading to project delays. To mitigate this risk, the project team will conduct rigorous compatibility testing throughout the integration process, as outlined in the prototype testing plan. This comprehensive testing includes ongoing monitoring of software-hardware interactions and allows for the prompt identification and resolution of any compatibility issues. In the event of unforeseen challenges, the team will allocate additional time for testing and modification to ensure a seamless software-hardware integration process. This methodical and proactive testing approach serves as a robust contingency to address potential risks associated with software and hardware integration.

6 Conclusion

In conclusion, the project's transition from concept to realization encompasses intricate phases, each demanding precision and careful planning. The detailed design phase serves as a critical pivot in this transformative process, thoroughly addressing material selection, cost estimation, software-hardware integration, and risk management. The prototype testing plan's pivotal role in mitigating risks and ensuring adaptability is underscored. Systematic testing allows the project team to identify and resolve issues early, reducing the likelihood of disruptions. The project demonstrates resilience and preparedness in the face of challenges, with a commitment to anticipating and addressing potential obstacles. As the project progresses through the detailed design phase, it is well-prepared to overcome complexities and uncertainties, poised for a successful transition from concept to reality. This strategic approach ensures the project's readiness for the subsequent phases, setting a strong foundation for innovation and success.

Wrike Snapshot:

https://www.wrike.com/frontend/ganttchart/index.html?snapshotId=iHTlolRJRgvj2jSQOTIPxrL1mLvjuOFn%7CIE2DSNZVHA2DELSTGIYA