MECHXPRESS

Mobile Auto Mechanic Unit

Eve Mills

Bachelor of Industrial Design

Mobile Auto Mechanic Work Station

Eve Mills

Submitted in partial fulfillment of the requirements for the degree of

Bachelor of Industrial Design

Faculty of Media and Creative Arts
Humber Institute of Technology and Advanced Learning

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2023-04-16

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Abstract

The accessibility to auto mechanics represents a significant challenge in the automotive industry, as it impacts individuals from diverse backgrounds and abilities. This topic encompasses several dimensions, including physical accessibility for people with disabilities, financial accessibility for those with limited resources, and educational accessibility for individuals with varying levels of automotive knowledge. This design topic aims to understand why existing solutions fall short in meeting the diverse needs of this user group and why it is imperative to bridge the accessibility gap within the automotive repair industry. The research will involve a meticulous evaluation and analysis of current automotive repair practices, accessibility barriers, and user experiences. Through user surveys, field observations, ergonomic studies, and interviews with auto mechanics and customers, it is intended to uncover the specific pain points and areas for improvement. Moving forward, a solution for the challenges faced in the auto mechanic industry will be developed. By improving accessibility in these areas, it can create a more inclusive and equitable automotive repair industry.

Keywords: Accessibility, Auto Mechanics, Accessibility Gap, Equitable

Acknowledgements

I wish to express my gratitude to Professor Catherine Chong, and Fredric Matovu for their consistent guidance and honest mentorship throughout the development of this thesis. Additionally, I extend my thanks to Michael Vander Velde, our classes teaching assistant, for his valuable assistance and commitment to enhancing the learning experience, as well as my advisor, Jacob Wilsack for his professional guidance on the topic.

Appreciation goes out to my loved ones for their support throughout school. I also want to acknowledge my fellow cohort members for creating a collaborative and motivating environment. Your shared enthusiasm and camaraderie made the academic journey more engaging and enjoyable.

I extend my thanks to everyone who played any role in my academic endeavor. Your contributions, whether big or small, have left a mark on this thesis and my overall educational experience.

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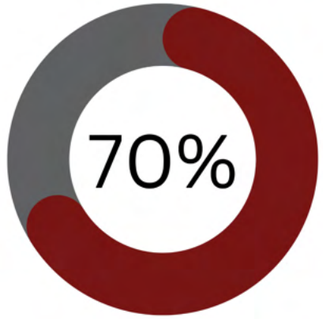
1.1 Problem Definition

In response to the evolving industry of automotive repair, there is a pressing need for innovative solutions that not only address current challenges but also remain relevant over the next decade. The COVID-19 pandemic has highlighted the significance of remote services, and after three years of remote work, individuals have expressed a desire for time-saving solutions. Access to reliable and convenient automotive services is particularly crucial, as an estimated 70% of Canadians lack the savings to cover unexpected vehicle repair costs (2024). The financial constraints, coupled with limited access to affordable and trustworthy repair services, emphasize the need for forward-thinking approaches like mobile mechanics. Unlike traditional garages, mobile mechanics offer a cost-effective alternative, with an average cost reduction of about 20 percent (Qosha, 2021). The accelerated growth of mobile repair, outpacing the overall market during the pandemic, highlights the potential for reshaping the automotive maintenance industry and meeting the changing expectations of consumers.

This project's primary objective is to explore how advancements in automotive repair services can address the changing dynamics and demands of the industry. The study will explore emerging technologies, the impact of remote work trends, and the evolving preferences of consumers when it comes to vehicle maintenance. The study will employ a multifaceted approach, incorporating surveys, interviews, and observations with key stakeholders, including auto mechanics, industry experts, and vehicle owners. By gathering comprehensive insights, the aim is to identify the challenges faced by consumers and professionals alike, highlighting the need for innovative solutions. The research will provide backing to design a product or service that not only caters to the current demands for accessibility and flexibility but also anticipates future trends, ensuring long-term relevance and effectiveness.



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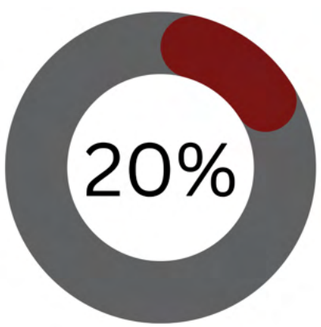

cost reduction with mobile auto mechanics.

1.2 Rational & Significance

To comprehensively understand the automotive repair service industry and enhance accessibility to auto mechanics, the study will employ a multifaceted approach. Through means of surveys, user observations, interviews, and academic resources, the research aims to systematically unveil the daily tasks performed by auto mechanics in Ontario, delve into the spectrum of current services offered by both traditional garages and mobile mechanics, and understand the different factors influencing consumers' access to auto repair. Key questions will explore the routine activities of mechanics, consumer preferences in service selection, and barriers faced by individuals seeking automotive services. By addressing these questions with a diverse methodology, the research endeavors to identify opportunities for innovation, streamline service delivery, and ultimately enhance access to auto mechanics. By addressing these questions, the research aims to identify opportunities for innovation, streamline service delivery, and ultimately enhance access to auto mechanics, catering to the evolving needs of both service providers and consumers.

1.3 Background / History / Social Context

The revenue trajectory of the automotive repair industry is intricately linked to the evolving demands of consumers, businesses, and government agencies. Despite a decline in industry revenue at a Compound Annual Growth Rate (CAGR) of 0.2%, reaching $11.5 billion by the close of 2023, a notable resurgence marked the same year with a 4.5% increase in profit, culminating at 7.8% (2023). This positive turn is primarily credited to the post-pandemic economic recovery, catalyzing increased demand as individuals regain confidence in travel. The anticipated growth in demand for mechanic services is further underscored by the projected increment in the average age of automobiles in Canada throughout 2023 (2023). With the resurgence of individuals returning to the roads, there is an anticipated uptick in the demand for mechanics. The year 2023 is poised to witness a slight increase in the average age of automobiles in Canada. This shift is noteworthy as older vehicles inherently require more frequent repairs, thereby contributing to the overall growth of the industry (2023). The growth rate of personal vehicles is expected rise in the total number of road motor vehicles registered in Canada, which reached 26.3 million in 2022, indicating a marginal 0.3% increase from 2021 (Government of Canada,2023). Interestingly, the COVID-19 pandemic has reshaped consumer behavior, with a notable boost observed in the mobile repair sector. The reluctance to leave homes or venture into traditional repair shops during the pandemic has propelled sales in 2020 and 2021 to levels 50% higher than those in 2019 (Malik, 2022). This surge is particularly pronounced among Generations Y and Z, as these demographics exhibit a preference for online transactions and display reduced interest in establishing personal relationships with traditional repair outlets, aligning seamlessly with the key buying preferences of these tech-savvy generations (Malik, 2022). The confluence of these factors paints a comprehensive picture of the automotive repair industry's landscape, where economic conditions, demographic shifts, and changing consumer behaviors converge to shape its trajectory.

Chapter 2 - Research

2.1 User Research

Surveys:

Through the initial surveys conducted, many invaluable insights pertaining to the industry emerged. One notable discovery was the overwhelming consensus among 60% of respondents who expressed a firm belief in the transformative potential of introducing mobile auto mechanics. This finding underscores a shared sentiment among survey participants regarding the pivotal role that mobile services could play in enhancing accessibility for customers seeking the expertise of mechanics.

An additional 60% of respondents identified the geographical distance to the dealership or mechanic shop as a primary challenge in accessing automotive services. This dual emphasis on the significance of mobility and proximity highlights a perceived gap in the current industry of auto mechanics, suggesting that the existing solutions may not be optimally addressing the accessibility needs of both mechanics and customers.

Several respondents also highlighted a prevailing issue within the automotive service industry, signaling a noticeable problem with communication and trust between auto mechanics and their clientele. The answers expressed by these respondents underscore a broader concern that extends beyond mere mechanical expertise, emphasizing the crucial role of transparent and trustworthy interactions in fostering a positive customer-mechanic relationship.

The survey responses collectively paint a picture of the industry's acknowledgment of an accessibility deficit. Mechanics, represented by survey participants, appear to align in the belief that a more innovative and agile approach, such as the provision of mobile auto services, could bridge the existing gap and redefine the customer-mechanic dynamic. Furthermore, the surveys shed light on the predominant issues customers typically bring to traditional auto mechanic shops. Through the current business on the market, it has been proven that these commonly encountered problems are conducive to mobile solutions. This insight not only reinforces the viability of a mobile approach but also implies that adapting to a mobile service model could potentially align more seamlessly with the prevalent needs of customers.

The preliminary survey results not only unveil a consensus among auto mechanics regarding the need for enhanced accessibility but also point towards a strategic shift in service delivery as a means to better address the challenges faced by both mechanics and customers in the current automotive industry.

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Interviews:

The insights derived from interviews conducted within the industry closely mirrored the trends identified in the survey responses. Two mechanics provided a real life perspective on the challenges and dynamics prevalent in the automotive service sector.

Interviewee #1, who regularly engages with customers, highlighted the complexities when it comes to customer service within the mechanics' realm. The interviewee highlighted the difficult nature of dealing with customer inquiries and concerns, attributing the difficulty to a historical context where previous technicians may have erred in diagnoses or attempted to upsell unnecessary services. This historical skepticism, as described by Interviewee #1, places a premium on the current mechanic's ability to navigate and rebuild trust with customers. Moreover, Interviewee #1, who frequently travels to job sites, underscored the importance of tool storage, organization, and accessibility in optimizing job efficiency. Recognizing the significance of a streamlined workflow, not only benefits the mechanic but also contributes to an enhanced experience for the customer, aligning with the overarching theme of efficiency and accessibility identified in the survey responses.

In contrast, Interviewee #2, primarily stationed in a static auto mechanic shop, provided insights into the challenges associated with customers not bringing their vehicles in regularly. This situation often results in a need for more extensive repairs than initially anticipated. Interviewee #2's perspective reinforces the notion that there is a pressing need for a more convenient and accessible means for customers to address routine maintenance and inspections, thus potentially averting more substantial repairs in the long run. Additionally, Interviewee #2 shed light on the financial considerations that impact customer engagement with auto mechanic services. The interviewee suggested that the existing service offerings contribute to the current financial gap, potentially dissuading some customers from seeking regular auto maintenance feeding into the loop. This financial aspect further underscores the necessity for the industry to explore more inclusive and cost-effective solutions to encourage a higher frequency of customer visits.

In summary, these interviews provided two very beneficial perspectives of the challenges faced by mechanics, encompassing customer trust-building, operational efficiency, and financial accessibility. The narratives shared by Interviewee #1 and Interviewee #2 collectively highlight the need for a new approach in redefining industry practices to foster stronger customer relationships and address underlying issues to regular auto maintenance.

Video Observation:

During a video observation of "A day in the life of a mobile auto mechanic," many challenges became evident, underlining the unique difficulties faced by professionals operating in this specialized field. The intricacies of their work environment presented hurdles that demand innovative solutions for seamless operations.

One of the prominent challenges noted was organizational issues. The constant movement and vibrations during transit led to difficulties in maintaining a well-organized workspace. The observation revealed instances where parts and drawers would unexpectedly dislodge, showcasing the need for robust organizational strategies tailored to the mobile nature of the mechanic's job.

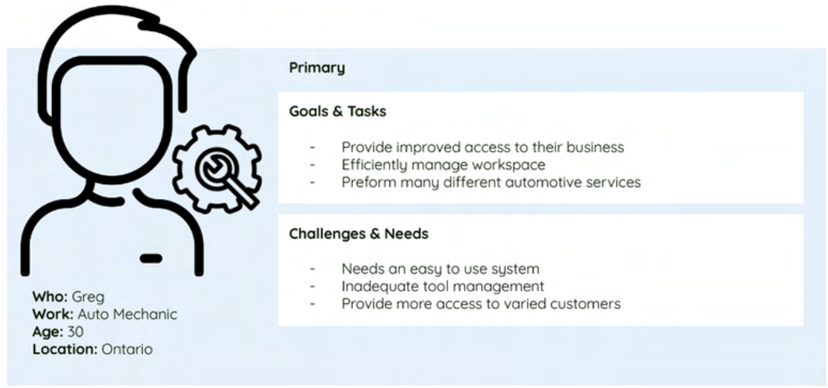
The issue of navigating back and forth between the vehicle and the workstation emerged as another significant challenge. The mobile auto mechanic must be in constant movement between the car being serviced and their truck's workstation, highlighting the importance of efficient spatial organization to minimize time wastage and maximize productivity.

In addition to these physical challenges, the video observation highlighted the importance of adequate lighting for signaling the mechanic's presence to others. The use of hazard lights (4-ways) was identified as a key safety measure, emphasizing the need for proper illumination to alert people to the ongoing work, especially in diverse outdoor settings.

Insufficient room from the jack, coupled with tools scattered on the floor, was also identified as a primary problem affecting the efficiency of the mobile auto mechanic. This challenge speaks to the necessity for creative solutions in equipment design and layout to optimize the available space and ensure a safe and organized working environment.

In summary, the video observation illuminated the many challenges faced by mobile auto mechanics, ranging from organizational hurdles to safety concerns. The insights gained highlight the importance of developing tailored solutions that account for the unique demands of this profession, ultimately enhancing the overall efficiency and effectiveness of mobile auto repair services.

2.1.1 User Profile - Persona



This thesis is specifically focused on auto mechanics, a profession historically dominated by men. In Ontario, only one percent of auto service technicians are female, highlighting a significant gender disparity in the industry (Galloway, 2020). While the primary audience is male auto mechanics, the thesis also needs to examine and address barriers preventing women from entering the field. The goal is to promote inclusivity and diversity within the traditionally male-dominated profession.

2.1.2 Current User Practice

In the current user practice within the auto mechanics field, professionals navigate a spectrum of tasks, categorized into routine and non-routine tasks. Routine tasks involve standardized maintenance procedures and inspections, with attitudes emphasizing precision and efficiency. Non-routine challenges, such as unique repairs or diagnostic complexities, demand adaptive procedures and a problem-solving mindset, reflecting a dynamic and resourceful approach. Contextual influences, including the work environment and customer interactions, further shape the auto mechanic's experience. If a customer does not seem to under why a mechanic is doing what they are doing, the job may become more difficult as the mechanic now has to deal with the social education aspect of the job. The ability to seamlessly transition between routine and non-routine tasks, coupled with an awareness of contextual nuances, highlights the comprehensive skill set required in the profession. This contributes to a dynamic and responsive user experience, ensuring that auto mechanics can adapt and meet the diverse needs of their clientele.

2.1.3 User Observation – Activity Mapping

Video Observation

1

Checks Car That Needs to be Serviced
- Auto Mechanic starts by checking the car and determining what is wrong

2

Moves Car
- Auto Mechanic realizes that the curb behind the car will get in the way of being able to access under the car since he only has smaller jacks and needs to push the car forward

3

Collect Tools
- Auto Mechanic must now go back into car to work truck to collect any tools needed
  - Mentions that it is messy
  - Mentions that if he does not lock drawers before driving, tools will fall out

4

Jacks Car
- Auto Mechanic jacks car up to be able to access cars underside

5

Goes Under Car
- Uses his creeper to roll under car and works on cars problem
  - Rolls out from under the car multiple times to access tools that are laying on the cement
  - Mentions that there is not much room under the car
  - Mentions that his neck is "killing me" from the awkward positions he is in

6

Takes Car Part Out From Under Car
- Auto mechanics take part out from under car so he can work on it / replace what needs to be
- Replaces fuel tank part and puts it back the same way it was taken out
  - As he is removing the part and rolling it out from under the car, his form and body looks unnatural in movement

7

Slowly Releases Jack
- Carefully lets the car down and has to put all his tools back in his work truck
  - Mentions that he has to be careful because it is still jacked on the other side
  - Mentions that wearing bright colours helps for higher viability

Task Mapping

Task: Changing a tire	Ergonomics	Efficiency	Interaction	Satisfaction
Gather Materials	Bending Reaching Walking to gather materials	If not stored properly takes a a lot of time to collect and then put back	Grabbing tools from storage	No - Messy
Lift Car with Jack	Manually pumping jack • Arm Pressure	Less efficient than automatic lift	Grip on jack handle	No - Take more work and time than a automatic lift
Loosen Lug Nuts	hold wrench with hand while collecting lug nuts	Easy if your hands have full range of motion and has to happen	Grip on wrench	Easy if your hands have full range of motion and has to happen
Replace tire	Lifting tire - surrounding cleared for safety	Takes a bit of time to carry heavy tire	• Grip on tire • Bending at the back to place down	Physically tiring
Tighten Lug Nuts	Use hands to manually tighten lug nuts - Grip strength	Easy if your hands have full range of motion and has to happen	Grip on wrench	Easy if your hands have full range of motion and has to happen
Let Car Down	Manually pumping jack • Arm Pressure	Less efficient than automatic lift	Grip on jack handle	No - Take more work and time than a automatic lift
Check Pressure	Checking tire presser involves put gauge onto tire	Easy if your hands have full range of motion and has to happen	Grip on gauge	N/A

Usability Issue Takeaways

- Organization: Lack of systematic organization in the mobile auto mechanic's workspace, leading to inefficiencies and potential delays in service.

- Parts Falling Out/Drawers Falling Out When Driving: Inadequate securing mechanisms for parts and drawers in the mobile workshop, posing a risk to both the mechanic and the tools/equipment during transit.

- Back and Forth Between Car and Workstation: Excessive movement between the vehicle being serviced and the portable workstation, potentially causing inefficiencies and extended service times.

- Uneven Ground: Challenges posed by uneven surfaces at job sites, impacting the stability of the mobile workshop and creating potential safety hazards for the mechanic.

- Lighting to Signal Presence (4 Ways): Insufficient lighting mechanisms to signal the presence of the mobile auto mechanic, particularly on roadsides or in dimly lit areas, potentially compromising safety.

- Not Enough Room from Jack: Limited space around the jack, hindering the mechanic's ability to perform tasks effectively and compromising the overall efficiency of the service.

- Tools on Floor: Presence of tools on the floor, potentially leading to disorganization,safty hazards, and difficulties in locating and accessing necessary equipment during service tasks.

2.1.4 User Observation – Human Factors of Existing Products

Current products in the auto mechanics market predominantly target experienced men, reflecting the historical male-dominated nature of the industry. This design approach may impact the usability for smaller women and potentially smaller men. Products such as tool storage chests, creepers, mobile hydraulic lifts, and truck tool storage are designed with assumptions about user physical requirements, potentially posing ergonomic challenges for a more diverse workforce. There's an opportunity for innovation to create more inclusive and user-friendly designs that accommodate the evolving demographics within the auto mechanics profession.

2.1.5 User Observation – Safety and Health of Existing Products

Current products in the auto mechanics industry consistently prioritize durability and material selection as well as safety features. These benchmarked products are characterized by robust construction using heavy-duty materials, providing resilience against wear and tear and ensuring a prolonged lifespan. Safety is a leading concern, leading to the incorporation of features like locking mechanisms, stability enhancements, and proper weight distribution, collectively fostering a secure working environment for auto mechanics.

In addition to these product characteristics, adherence to Occupational Safety and Health Administration (OSHA) regulations significantly influences product design. Compliance with OSHA standards, encompassing aspects such as proper labeling, guarding, and ergonomic considerations, is imperative (2018). This extends to addressing challenges related to material handling and chemical exposure, aligning with OSHA regulations to guarantee a safe and healthy workplace for auto mechanics. The integration of these elements highlights the industry's commitment to both durability and safety, meeting strict regulatory standards and catering to the unique needs of auto mechanics.

2.2 Product Research

2.2.1 Benchmarking – Benefits and Features of Existing Products

Physical accessibility to cars

Car lifts

Addresses the challenge off access to under the vehicle
* requires mechanics to stand in uncomfortable positions

Mechanic Creepers

Addresses the challenge off access to under the vehicle
* requires mechanics to hold their head in uncomfortable positions

Wireless inspection camera

Addresses the challenge mechanic no being able to reach certain spots/angles . Allows mobility for mechanic

Jacks

Helps lift the car up on a smaller level. Can only lift the car so high

Workspace improvement

Adjustable lighting systems

Improved visibility to mechanics. more mobile/ adjustable

Swivel chair

Helps mechanic freely move around while having the comfort the sit. Would have a hard time moving over chords on the floor

Lift adaptors

Accessories to add to lifts

Magnetic tool holders

Addresses the challenge of having poorly organized mechanic tools

2.2.2 Benchmarking – Functionality of Existing Products

Functionality Takeaways

Efficient organization in tool storage products enhances functionality, offering mechanics streamlined access to their equipment. Innovations like the creeper prioritize accessibility and comfort, facilitating easy maneuverability beneath vehicles while reducing physical strain. Mobile hydraulic lifts provide a versatile solution for raising vehicles, boasting compactness and portability, though they necessitate a power source to accompany them. Truck tool storage, tailored for mobile requirements, primarily remains stationary outside of the truck.

2.2.3 Benchmarking – Aesthetics and Semantic Profile of Existing Products

Product	Shape	Size	Material	Technology	Colour
	• Angular • Pyramid	• Compact	• Metal	No	• Red • Black
	• Straight lines • Boxy	• Compact	• Metal • Fabric • Foam	No	• Green • Black
	• Circular • Bulky	• Compact	• Magnetic Metal	No	• Red • Black
	• Circular • Cylindrical	• Compact	• Metal • Fabric • Cushion • Plastic	No	• Orange • Black
	• Cylidrical • Angular • Rectangular	• Compact	• Metal • Rubber • Plastic	No	• Yellow • Black
	• Straight lines • Boxy	• Compact	• Plastic • Glass	Yes	• White • Black

Aesthetic Takeaways

The prevalent design trend in the product offerings is characterized by a rugged aesthetic, with an overarching theme of durability and toughness. Across all products, the color palette prominently features the shade black, contributing to a bold and robust visual identity. The strategic addition of additional colors, mainly red and yellow, serves to accentuate key elements and draw attention to important features. This color combination not only reinforces the rugged appearance but also conveys a sense of energy and visibility. The consistent use of black, along with the selective incorporation of red and yellow, creates a cohesive and impactful design language across the product lines.

2.2.4 Benchmarking – Materials and Manufacturing of Existing Products

Materials

Auto mechanics equipment is primarily selected based on functionality and durability. While aesthetics are a consideration, they don't play the primary role in decision-making when it comes to making purchases which is why the material is such an important factor.

Tool Storage

When considering current tool storage options, three main materials—wood, plastic, and metal—come into focus. While each material has its own set of pros and cons, metal emerges as particularly well-suited to meet the overall wants and needs of auto mechanics.

Wood	Plastic	Metal
 (Lowes)	 (Black + Decker)	 (Durhand)
Cost: $193	Cost: $186.62	Cost: $319
Durability: Medium	Durability: Low-Medium	Durability: High

Upon examining the current market materials and their respective prices, it becomes evident that metal options are the most expensive, while plastic alternatives are the most economical. However, it is noteworthy that their prices remain quite comparable. In considering sustainability, the lifespan of the product becomes a crucial factor, which is why metal tool chests are often favored. Among the available materials, steel tool chests stand out as the most durable option (GlobalSpec).

In assessing sustainability, it's crucial to examine how the chosen material impacts other components within the mechanical system. Wood is often preferred for its unique quality of possessing a relatively high thermal insulative value. This characteristic ensures optimal temperature control, reducing the likelihood of tools inside the storage experiencing rusting (Covingtonandsons, 2023). This factor also becomes evident when considering durability. Steel tool chests, being the most durable (GlobalSpec), play a crucial role in ensuring tool safety and minimizing the need for property replacement ie. getting thrown out. On the contrary, plastic, lacking in durability for its intended purpose, may require more frequent replacements, leading to a shorter lifespan and more wastage, but provide a lightweight solution.

When considering the end-of-life phase for product materials, recycling emerges as a key strategy to mitigate environmental impact. Wood, known for its recyclability, often requires processing at specialized facilities where it undergoes careful assessment, grading, and sorting (Nick, 2023). On the other hand, certain types of plastic can be recycled, but the quality tends to degrade after 2-3 cycles. It's worth noting that only a reported 5% of plastic is effectively recycled (Sullivan, 2022). Metal, particularly steel, is notably advantageous in terms of recycling, as it can be recycled 100% without any loss of quality (2023). However, it's essential to consider whether the metal is coated with any substances during the recycling process. Many coatings can be recycled alongside the metal, for those that can't, they are easily removable before the recycling process begins (Powdertech Surface Science). In addition to tool chests, steel is the predominant material utilized in the construction of hydraulic lifts used by auto mechanics everyday (Industrial Quick Search).

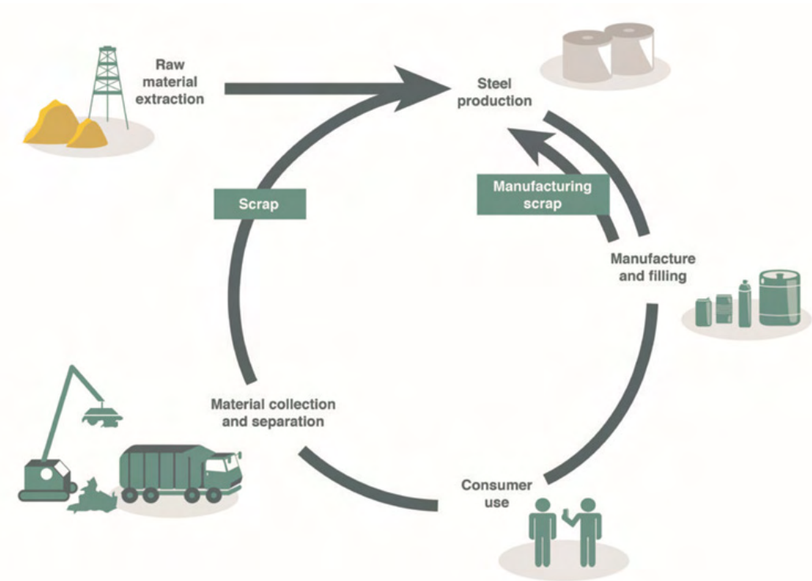


Figure1 Lifecycle (APEAL, 2020)

Finally, silicon is a frequently used material for coating tools and equipment. However, it falls short in terms of environmental friendliness. The production of silicone involves hydrocarbons derived from petroleum, making it unsustainable. Recycling silicone is challenging, as most facilities do not accept it thus making it not the most desirable material (2022).

Alternative materials

When plastic is considered the optimal material, exploring superior alternatives, such as bioplastics is crucial. One noteworthy example is PLA, derived from corn, which is gaining widespread acceptance among producers. This material distinguishes itself with eco-friendly attributes, utilizing only 1/3 of the energy required for common plastics production. Moreover, PLA emits 70% fewer greenhouse gasses during landfill degradation, contributing to an overall reduction in emissions by 25% or more (RoadRunner).

Lastly, a material with similar properties to silicon is natural rubber. Rubber is notable for being a natural and renewable resource that can be recycled (Airboss of America, 2023). In addition, rubber is considered a rapidly renewable resource, with a harvest cycle of less than 10 years. This characteristic, coupled with its tendency to require fewer inputs, contributes to a lower environmental impact overall (Airboss of America, 2023).

Manufacturing

Selecting appropriate materials is crucial not only for sustainability but also for functionality and manufacturability. Current manufacturing techniques for metal tool chests primarily involve metal bending and puncturing, followed by securing the components with bolts and welds (2016).

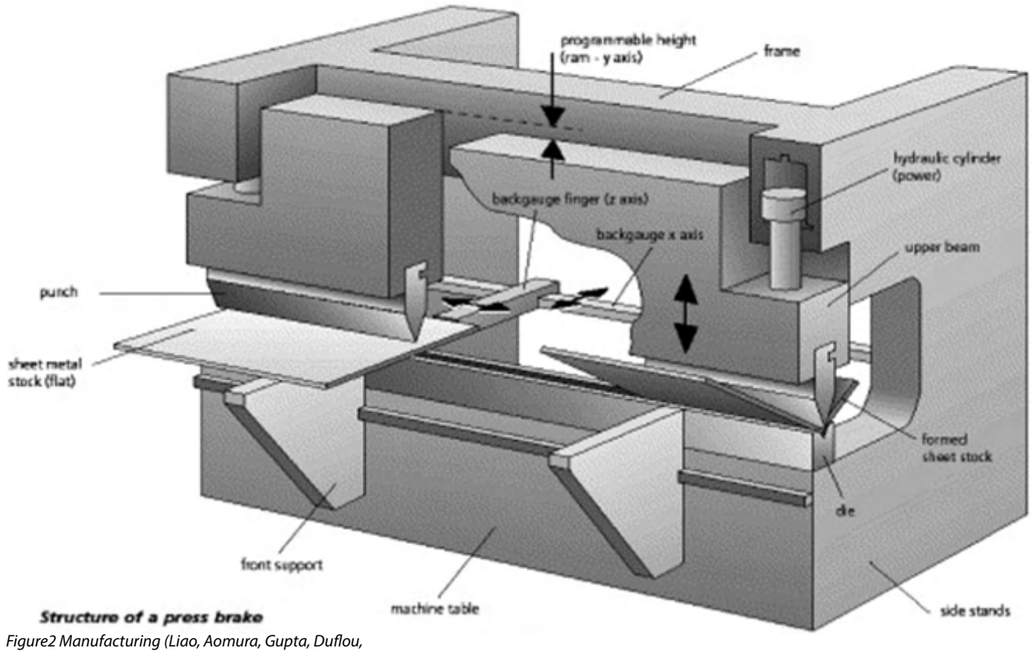


Figure2 Manufacturing (Liao, Aomura, Gupta, Duflou,

The final step in the process is powder coating, a method employed to enhance the product's longevity (2016).

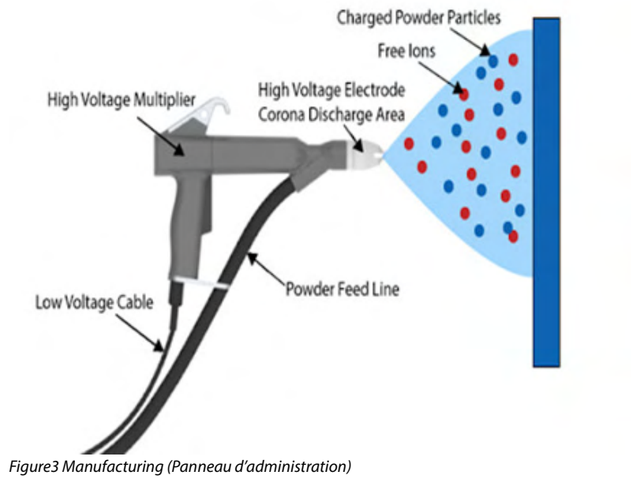


Figure3 Manufacturing (Panneau d'administration)

Handles are typically pressed into metal doors during the manufacturing process. However, when handles are considered an additional part in the assembly, hydroforming is the method of choice (Ismadmin, 2019). Hydroforming offers a method to intricately shape metal tubes while preserving their strength.

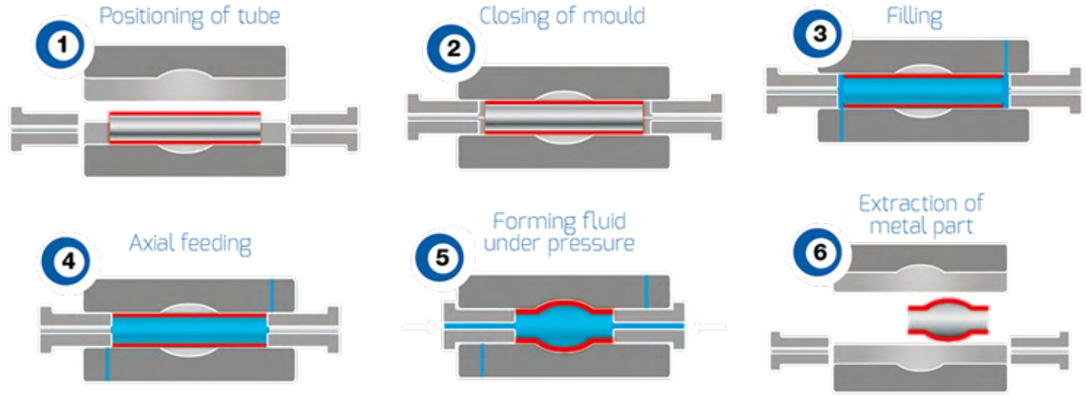


Figure4 Manufacturing (Inoxveneta, 2020)

2.2.5 Benchmarking – Sustainability of Existing Products

In the context of designing products for the auto mechanics industry, material selection emerges as a critical factor, given the physically demanding nature of the subject matter. To ensure the resilience and longevity of the products, a deliberate emphasis on robust materials is important. Steel alloys, renowned for their strength, form a foundational choice, particularly in constructing components like tool storage chests and mobile hydraulic lifts. Heavy-duty plastics, engineered for toughness, contribute to weight reduction without compromising strength, ideal for various product elements. The use of powder-coated finishes not only enhances aesthetics but also provides an additional layer of protection against wear and corrosion. In aligning with the rugged and challenging environments of auto mechanics, the strategic selection of strong materials highlights a commitment to durability and product performance.

Product	Material	Price	Weight	Sustainability	Strength
	Polypropylene	$1,282.57	38.1 x 57.91 x 45.72 cm; 0.28 Grams	Relatively low carbon foot print but not fully sustainable	45.36 Kilograms
	Steel	$314	70lb	Sustainable since when steel is made once it can be used over and over again	300 LB
	Wood	$1,725	22 LB	Renewable & Recyclable	31 LB

As previously mentioned, steel remains the primary material of choice for manufacturing tools used by auto mechanics, including tool chests and hydraulic lifts. The selection of steel as the primary material appears to be the current optimal choice, meeting the durability requirements of the job while also aligning with environmental considerations. Manufacturing with materials that are tailored for the intended purpose not only meets performance requirements but also prioritizes the health and safety of the users. This ensures that the tools do not break or pose harm during use.

As of now, Dewalt, a leading manufacturer of power tools and workshop storage solutions, is dedicated to minimizing its environmental impact. When any Dewalt product reaches the end of its life cycle, consumers can send it to the designated address, where the company ensures proper recycling of the product (DEWALT).

Milwaukee, another prominent brand in the workshop industry, offers a range of power tools and workshop storage solutions. Their current product lineup reflects a commitment to sustainability, with over 90% of their electricity sourced from renewable sources, generating nearly 30,000,000 kWh/year in renewable energy. In a further effort to reduce environmental impact, Milwaukee has upgraded to high-efficiency HVAC equipment in half of their facilities, resulting in decreased energy consumption. Additionally, their commitment to waste reduction is evident, diverting more than 200,000 lbs of plastic from landfills annually across their facilities (Milwaukee).

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Analysis: Materials & Manufacturing

Based on the information gathered, it is advisable to adhere to a proven approach. For materials, stainless steel stands out as the optimal choice, being both sustainably 100% recycled and durable enough to meet the job's strength requirements. The evaluation of various steel types is crucial, and certain steels, like carbon steel, may not align with the required conditions that stainless steel does, particularly in terms of corrosion resistance and thermal conductivity, as outlined below. When it comes to coatings for grip, opting for natural rubber over silicone offers the necessary properties while being more environmentally friendly. This strategy strikes a balance between performance, sustainability, and reduced environmental impact in the workshop industry. The manufacturing method of bending and welding will remain the preferred choice, as it consistently delivers optimal outcomes in terms of quality, cost-effectiveness, and sustainability.

Figure5 Manufacturing (Drew, 2022)

2.3 Summary of Chapter 2 – Topic Understanding

In analyzing existing products in the auto mechanics industry, key takeaways emerge. Functionality considerations prioritize efficient organization in tool storage but pose limitations in the mobility of bigger tool storage products. Aesthetic trends emphasize a rugged design with a bold black color palette, complemented by strategic use of red and yellow. Material choices, including robust steel alloys and heavy-duty plastics, reflect a commitment to resilience and longevity. Sustainability is seen through the strategic selection of strong materials, aligning with the demanding nature of auto mechanics. These insights provide a foundation for addressing industry challenges and fostering innovation.

Auto Mechanic Accessibility Eve Mills

Chapter 3 - Analysis

3.1 Analysis – Needs
3.1.1 Needs / Benefits Not Met by Current Products
3.1.2 Latent Needs
3.1.3 Categorization of Needs
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3.7 Defining Design Brief

3.1 Analysis – Needs

Current auto mechanics products face many different challenges. Addressing these issues presents opportunities for enhancing accessibility, efficiency, and inclusivity in future product designs.

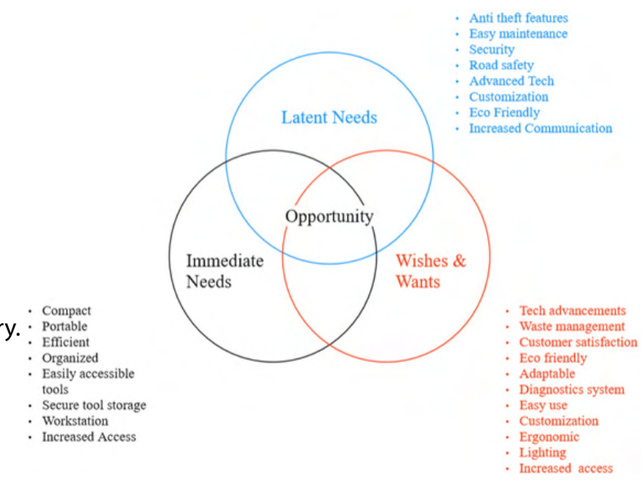
3.1.1 Needs / Benefits Not Met by Current Products

Current auto mechanics products fall short in meeting critical needs, notably in the areas of accessibility, tool storage, mobility, and customer communication/trust. Accessibility to mechanics is hindered by limitations in the mobility of tool storage solutions, restricting the seamless transport of tools to various job sites. Tool storage itself faces challenges, lacking user-friendly organization that would optimize efficiency in tool retrieval and storage while working on a vehicle. Moreover, the current products may not adequately address the mobility needs of mechanics, especially in terms of truck tool storage, which is generally immobile outside of the truck. Additionally, there is a notable gap in addressing communication and trust between mechanics and customers, suggesting a need for improved features or mechanisms to enhance customer interaction and confidence in the auto mechanics' service. These unmet needs underline opportunities for innovation and enhancement within the auto mechanics product landscape.

3.1.2 Latent Needs

Latent needs in the realm of auto mechanics products extend to essential aspects such as anti-theft features, easy maintenance, security, and road safety. The demand for anti-theft features highlights a desire for enhanced protection of valuable tools and equipment, requiring innovative solutions to deter theft and ensure the security of assets. Easy maintenance is a latent need indicating a preference for products that are user-friendly, allowing mechanics to perform routine upkeep effortlessly, ultimately contributing to prolonged product life and optimal functionality thus saving money in the long run.

Additionally, the latent need for road safety features signifies a growing awareness of the importance of products that contribute to a secure and hazard-free working environment, particularly for mechanics who operate on job sites or alongside roadways. Recognizing and addressing these latent needs presents opportunities for the development of products that align more closely with the evolving demands and preferences within the auto mechanics industry.



3.1.3 Categorization of Needs

Physiological Needs:

- Adequate compensation, access to safety gear, and a comfortable working environment are funda mental for meeting physiological needs.
- Ensuring that mechanics receive fair pay, have proper safety equipment, and work in a well-maintained shop contributes to fulfilling the bare needs of needs of food, shelter, rest, and safety.

Safety Needs:

- Job security, a safe workspace, and protection from workplace hazards are essential for addressing safety needs.
- Providing job stability, implementing safety protocols, and maintaining a secure working environment help fulfill the safety needs of auto mechanics.

Social Belonging:

- A sense of camaraderie, teamwork, and positive workplace relationships contribute to social belonging.
- Encouraging a collaborative work environment, and promoting a supportive culture enhance social belonging. Additionally, this can be enhanced with proper customer communication.

Esteem:

- Recognition, respect, and opportunities for skill development contribute to fulfilling esteem needs.
- Acknowledging and rewarding mechanics for their expertise, providing avenues for professional growth, such as providing them with proper tools that help properly complete a job. Properly completing a job will have a domino effect of increased respect due to one intelligence on the specific topic that is auto mechanics.

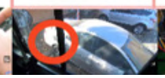
Self-Actualization:

- Opportunities for creativity, problem-solving, and professional growth are essential for self-actualization.
- Offering challenging projects, encouraging innovation, and providing avenues for skill advancement contribute to fulfilling the self-actualization needs of auto mechanics, such as completing a difficult job.

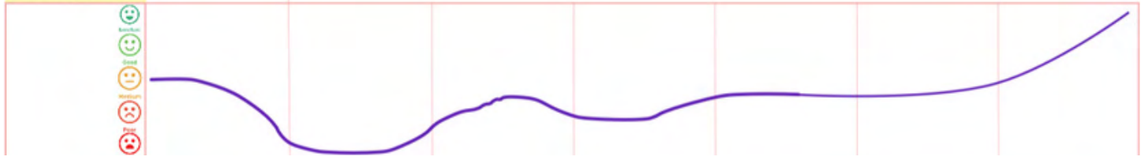
Summery

In summary, addressing the physiological, safety, social, esteem, and self-actualization needs of auto mechanics is a necessary approach to their well-being and professional development within the framework of Maslow's Hierarchy of Needs.

3.2 Analysis – Usability
3.2.1 Journey Mapping

Key Tasks	Diagnostics	Moving Car	Collecting Tools	Jacking Car	Going Under Car	Replacing Car Part	Releasing Jack
Goals	Figure out what is wrong with the customers car	Get the car away from the curb to the under part is more easily accessible	Bring all the tools that are required for this specific job out to where the work is being done	Lift the car up enough that the under parts of the car are accessible	Fix what is wrong with the car	Fix what is wrong with the car	Safely finish job so they can move on to the next
Thoughts	I wish the car could tell me whats wrong	I don't want to push this i wish i could leave it hear	Too many tools in disorganization	This is tiring	Am I going to fit	I am uncomfortable	More work on the arms
Feelings	interested and confused	annoyed	annoyed	hopeful	worried	Uncomfortable	Tired
Actions	* Turning the car on and off * Looking under it to diagnose * Assessing the problem	Physically pushing car since it will not turn on	* Picks up tools from indies the truck and brings them out * Has to take multiple trips	* Slides jack under car and manually pumps it to lift car up * Has to do this for both sides of car	* Lays down on creeper to roll under car and work on it	* Lays down on creeper to roll under car and work on it	* Slowly manually lets car down and rolls jack out
							

3.2.2 User Experience

Key Tasks	Diagnostics	Moving Car	Collecting Tools	Jacking Car	Going Under Car	Replacing Car Part	Releasing Jack
Goals	Figure out what is wrong with the customers car	Get the car away from the curb to the under part is more easily accessible	Bring all the tools that are required for this specific job out to where the work is being done	Lift the car up enough that the under parts of the car are accessible	Fix what is wrong with the car	Fix what is wrong with the car	Safely finish job so they can move on to the next
Problem/Challenges	* Turning the car on and off * Looking under it to diagnose * Assessing the problem	* Putting the car in neutral and pushing it forward	* Picks up tools from indies the truck and brings them out * Has to take multiple trips	* Slides jack under car and manually pumps it to lift car up * Has to do this for both sides of car	* Lays down on creeper to roll under car and work on it	* Lays down on creeper to roll under car and work on it	* Slowly manually lets car down and rolls jack out
Takeaways	Potential for AI assistance	Provide a solution that allows auto mechanic to leave car where it is and not have to move it	Provide a way that will make to tools themselves more mobile	Provide a lift that is me mechanical rather than manual	Provide a lift that can lift the car higher	Provide a better way of taking / transportation of car part from car and back	* I am tired * Happy the job is done with not problems and can go on to the next
User Experience							

Primary User

Who: Greg
Work: Auto Mechanic
Age: 30
Location: Ontario

Say:
"I want to offer my expertise to more people."
"It's essential to build trust with new customers."
"Understanding diverse vehicle models and issues is crucial."

Think:
"How can I effectively communicate my skills to potential customers?"
"Expanding services requires adapting to various customer expectations."
"Building a reputation for reliability is key."

See:
Various car models and brands.
Competing auto shops successfully expanding their customer base.
Online platforms.

Do:
Research market trends and customer preferences.
Invest in ongoing training to stay updated on the latest automotive technologies.
Try to tell more people about their business

Pain:
Wanting to increase accessibility but not knowing how
Ensuring consistent quality of service with a growing workload.
Navigating the competitive landscape in the automotive industry.

Gain:
Increased revenue through a broader customer base.
Professional growth and satisfaction.
Building a reputable brand known for reliability and expertise.

3.3 Analysis – Human Factors

In the development of an optimally designed mobile auto mechanic unit, this ergonomic study focused on obtaining 1:1 measurements to understand the spatial requirements of said unit. The aim of the study centered around what measurements are needed, and the approach involved physically creating a 1:1 representation of the unit to bridge the gap between theory and physical. Through this study, the aim was also to contribute insights that enhance both the functionality and ergonomic efficiency of the mobile auto mechanic unit, ensuring a seamless integration of design considerations into practicality.

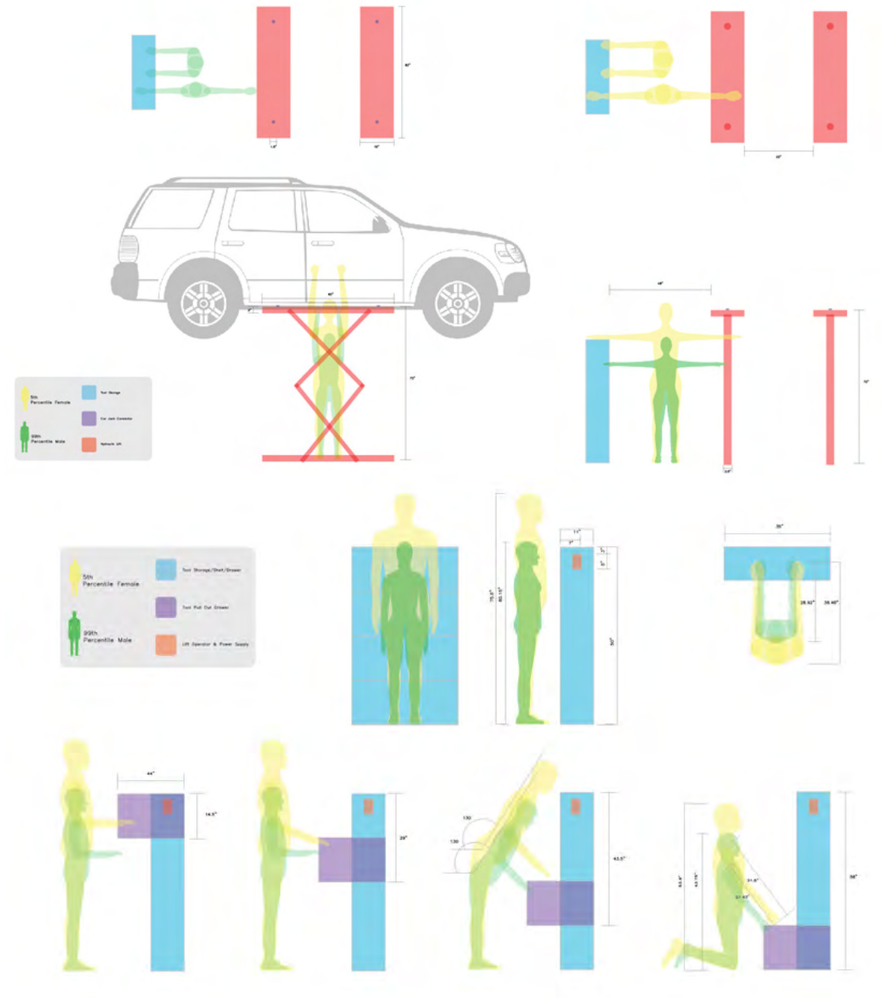
The ergonomic and human factor references in this study draw from a diverse range of sources, notably including insights from Henry Dreyfuss's work, "The Measure of a Man and Woman." Dreyfuss's exploration of measurements forms a foundational basis for understanding human dimensions in design, specifically the 99th percentile male measurements that were used in this study. Additionally, another relevant source used was from a summary Statistics Interim Report, adding a quantitative dimension to the ergonomics mainly the 5th percentile female measurements used in this study. By incorporating insights from these sources, the study aimed to offer a deeper understanding of ergonomic considerations.

This ergonomic study is centered on two key elements important to the development of the mobile auto mechanic unit: the hydraulic lift and the movable tool station. Additionally, a smaller yet important feature—the control panel for the hydraulic lift—has been integrated into the study. This study aimed to provide insights into the ergonomic considerations essential for the successful integration of these features within the mobile auto mechanic unit. The investigation into the movable tool station was driven by the intention to determine the optimal space required for storing essential tools while ensuring easy accessibility for auto mechanics during their work. To achieve this, a 1:1 model constructed from cardboard was used, with dimensions inspired by a combination of various tool storage systems. This approach aimed to strike a balance, avoiding designs that proved either too big or overly small. The schematics provided below detail the measurements used in this 1:1 study. The primary objective of the hydraulic lift study was to visualize the size ratio in relation to the tool storage and the human body, focusing on how these components integrate and interact within the mobile auto mechanic unit. The study aimed to determine the optimal spatial requirements between the hydraulic lift and the tool storage, considering the practical aspects of human interaction. Through this examination, the overarching goal is to identify an ideal configuration that harmonizes operational efficiency with spatial constraints.

Accessing mechanic tools: Hand, Arms and Legs
Accessing car: Hand, Arms and Legs
Operating hydraulic lift: Hands

3.3.1 Product Schematic – Configuration Diagram

The studies of Product Schematic and Configuration Diagrams are pivotal in the developmental process, serving as crucial precursors to Ergonomic studies. A Product Schematic provides a comprehensive visualization of the product's physical structure, offering a foundational understanding of its components and how they interact. Configuration Diagrams help decide the potential arrangements of product elements, emphasizing user interactions. These studies are paramount as they facilitate a smooth transition into Ergonomic analyses, where the focus shifts towards optimizing user experiences and ensuring ergonomic compatibility. Armed with insights from the earlier studies, designers can make informed decisions during the Ergonomic study, identifying areas for improvement in user comfort, reducing strain, and enhancing overall usability. This comprehensive approach to understanding product structure and user interactions influences the design decisions of this project by grounding them in a factual context, fostering a design process that continuously refines the final product to meet the highest ergonomic standards and user expectations.



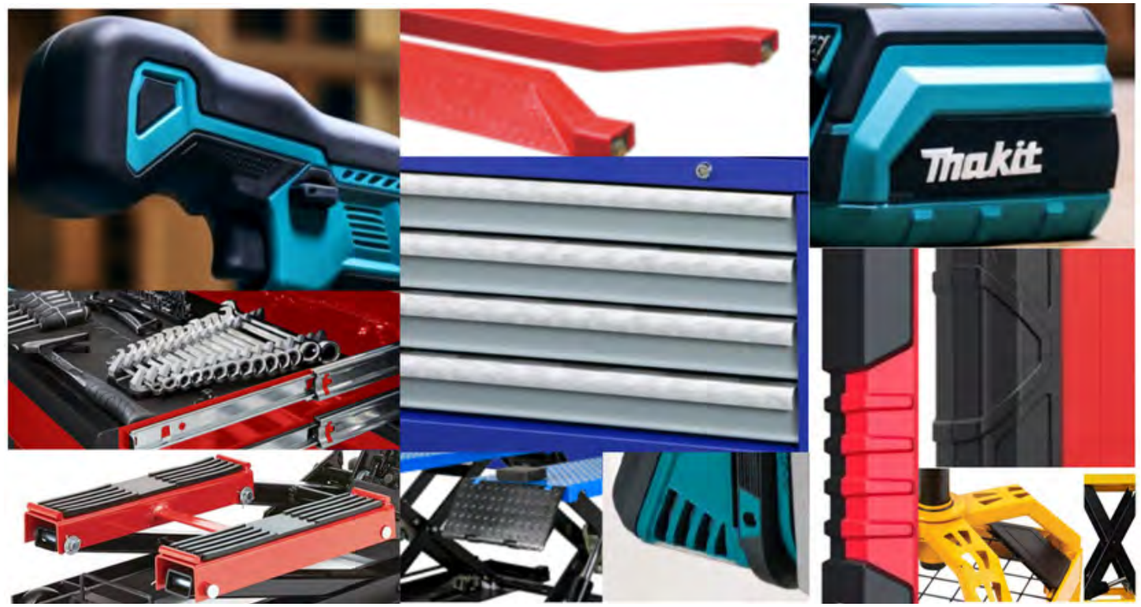
3.3.2 Ergonomic – 1:1 Human Scale Diagram

Much like Schematics, Human Scale Diagrams hold immense importance in this design process as they visually represent the size and proportion of objects or spaces relative to the human body. The diagrams facilitate spatial awareness by allowing designers to convey the scale of spaces, aiding in the visualization of user experiences. Moreover, these diagrams contribute to aesthetic appeal by guiding decisions on proportions and layouts. Embracing inclusivity, Human Scale Diagrams help create designs that accommodate diverse user needs and abilities.

3.4 Analysis – Aesthetics & Semantic Profile

In design, symbolism, aesthetics, and the language of meaning blends—semantics—to create visually appealing and culturally relevant products. Keeping an eye on current trends and tech ensures our designs stay fresh and innovative, meeting the needs of today's users. Form giving, inspired by the creativity and functionality seen below, the shapes the unique physical appearance products. Inspiration is drawn from various sources, infusing creativity into designs. External influences, like culture and society, add context and relevance to designs such as what is true needed by the desired user. This simple yet comprehensive approach ensures designs not only look good but also resonate with users in a meaningful way, reflecting the current trends and technology landscape.

The functionality of a compact design is harnessed alongside the rugged design language prevalent in most mechanical products. This combination integrates efficiency and durability, aiming to optimize space and resources while ensuring robust performance in line with the industry's tough standards. The compact design focuses on streamlining features for efficiency and portability, catering to practical user needs. Meanwhile, the rugged design language, synonymous with durability and sturdiness, contributes to the product's resilience and ability to withstand challenging working environments commonly encountered in auto mechanics settings. This design aims to provide a versatile and reliable solution, seamlessly blending the advantages of compactness with the hard-wearing attributes inherent in mechanics product designs.



3.5 Analysis – Sustainability: Safety. Health, and Environment

The benchmarking of materials reveals that steel is a sustainable choice due to its 100% recyclability and durability, aligning with the industry's requirements. This supports a sustainable initiative by reducing the environmental impact through the reuse of materials. Additionally, the consideration of bioplastics, like PLA, and natural rubber as alternatives highlights a commitment to eco-friendly materials, contributing to overall sustainability efforts.

In terms of manufacturing, the preference for metal bending, puncturing, and powder coating in the production process aligns with sustainable practices. These methods contribute to product longevity, minimizing waste in the manufacturing process and supporting a sustainable approach to manufacturing.

The consideration of health is subtly addressed through the deliberate choice of robust and dependable materials, notably exemplified by the preference for steel. Opting for stainless steel, specifically, serves as a proactive measure to diminish the risk of rust, a concern more pronounced in materials like carbon steel. This reduction in the likelihood of rust not only safeguards against potential product damage and breakdown but also mitigates the risk of injuries, minimizing the chance for cuts and averting the growth of bacteria that could lead to tetanus.

Material choices, especially the preference for steel, contribute to product safety by ensuring durability and reliability. This aligns with safety considerations, as durable tools are less likely to malfunction or pose risks during use. The manufacturing methods employed, such as metal bending and puncturing, contribute to product safety by enhancing structural integrity.

Durability is crucial for a mechanic workstation, ensuring a prolonged lifespan and promoting sustainability by minimizing the need for frequent replacements. The findings of this report highlights sustainability through a thoughtful selection of materials and manufacturing processes. Prioritizing functionality and durability, the choice of stainless steel as a primary material reflects sustainable commitment to 100% recyclability and long-lasting product performance. The exclusion of less sustainable options, such as certain steel types and environmentally unfriendly materials like silicone, highlights the dedication to responsible material resourcing.

The manufacturing approach aligns with sustainability, utilizing techniques such as metal bending, puncturing, and powder coating to ensure product longevity and contribute to waste reduction. Additionally, the design extends its sustainability focus to end-of-life considerations by incorporating recyclable materials like stainless steel.

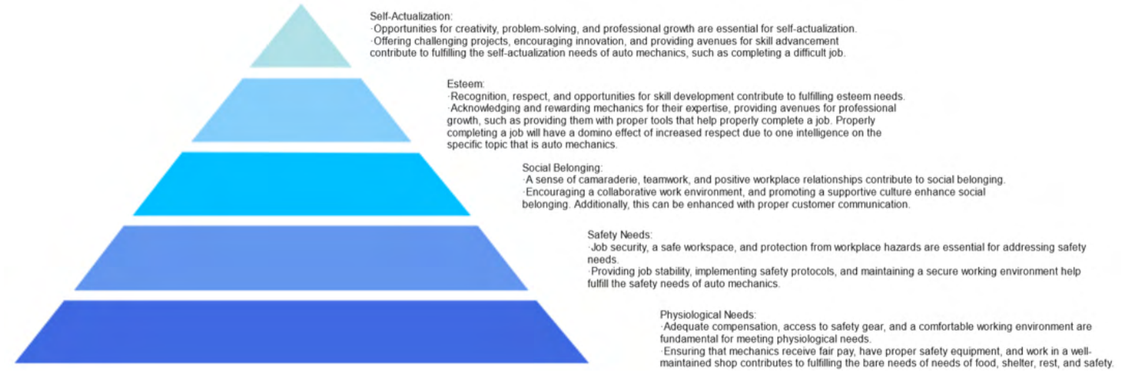
Incorporating these sustainable materials and manufacturing methods aims to enhance and elevate the sustainability of the mechanic industry.

3.6 Analysis – Innovation Opportunity

In the current market, individual products such as mobile hydraulic lifts and truck workstations are readily available, each serving specific functions in the realm of auto mechanics. However, a notable gap exists in the market—a lack of a combined solution designed explicitly to function as a mobile auto mechanic station. This gap provides a promising opportunity for innovation, where the integration of a mobile hydraulic lift and a truck workstation could create a comprehensive and versatile solution tailored to the unique needs of auto mechanics. An integrated station could streamline the workflow, offering mobility, accessibility, and a dedicated workspace all in one. This innovation not only addresses practical challenges faced by auto mechanics but also has the potential to redefine efficiency and convenience in the automotive repair industry.

In the pursuit of developing a new product, careful consideration must be given to its practicality and sustainability. Assessment of the availability of necessary technology and testing it through prototypes is how the project move forward. The design is evaluated to see how well the product fits into existing processes and whether users will find it user-friendly.

3.6.1 Needs Analysis Diagram



Problem:

Auto mechanics lack adequate workstations and accessibility in mobile workshop settings.

Why:

- Limited Workspace: Current setups often lack sufficient space for mechanics to work comfortably and efficiently.
- Lack of Tools and Equipment: Mechanics may not have access to all the necessary tools and equipment required for various repair tasks due to lack of storage space.
- Mobility Constraints: Mobile workshops may not be designed to easily access all areas of a vehicle, hindering the mechanic's ability to perform thorough inspections and repairs.
- Inefficient Workflow: Without proper workstations and tools, mechanics spend more time searching for equipment or improvising solutions, leading to delays in completing repairs.
- Quality of Service: Limited workspace and accessibility can compromise the quality of repairs performed, potentially leading to customer dissatisfaction and return visits for the same issue.
- Safety Concerns: Inadequate workstations and accessibility could increase the risk of accidents or injuries for mechanics working in constrained or poorly designed environments.
- Business Impact: Decreased efficiency and potential quality issues can negatively impact the reputation and profitability of auto repair businesses.

3.6.2 Desirability, Feasibility, & Viability

Desirability:

An auto mechanic mobile workstation offers a comprehensive solution to the countless challenges faced by mobile auto mechanics in their daily operations. By addressing issues such as limited workspace, lack of tools and equipment, mobility constraints, and safety concerns, it enhances efficiency and service quality. Its design not only improves the mechanics' workflow but also ensures customer satisfaction, ultimately boosting the reputation and profitability of auto repair businesses. This workstation is not just a convenience; it changes the way mechanics work, making it a highly desirable solution for both mechanics and customers alike.

Viability:

An auto mechanic mobile workstation demonstrates clear viability in its capacity to substantially optimize the efficiency of mobile auto repair operations. By effectively mitigating current workspace constraints, enhancing tool accessibility, and addressing mobility challenges, it fosters a more streamlined workflow for mechanics, ultimately resulting in heightened productivity and heightened client satisfaction. Designed to streamline processes and elevate service standards, this workstation emerges as a promising asset for fostering sustainable growth and profitability within the automotive repair sector.

Feasibility:

The feasibility of implementing the auto mechanic mobile workstation is highly promising, primarily due to the existence of current technologies, materials, and manufacturing methods. Leveraging existing technological advancements in storage solutions and workspace optimization ensures that the workstation design can be effectively realized. Similarly, utilizing readily available materials and established manufacturing techniques enhances cost-effectiveness and scalability. Additionally, the mobile nature of the workstation aligns seamlessly with current trends in on-site service delivery, meeting the evolving needs of customers in the automotive repair sector.

3.7 Defining Design Brief

Opportunity for Innovation:

The opportunity for innovation lies in revolutionizing the mobile auto mechanic industry by addressing the existing challenges faced by mechanics and customers. Introducing a brand new system has the potential to fundamentally change the way people work in this industry, offering solutions that enhance efficiency, quality, and overall customer satisfaction.

Research-Driven Evidence-Based Approach:

This design is grounded in thorough research and analysis of the current state of the mobile auto mechanic industry, including customer needs, pain points, and technological trends. By utilizing data-driven insights, it ensures that the design decisions are informed by real-world evidence and aligned with the demands of the market.

Key Guidelines for Design:

1. Optimized Workspace: Create a workstation design that maximizes space utilization and ensures ease of movement for mechanics.
2. Comprehensive Tool Accessibility: Ensure that all necessary tools and equipment are easily accessible to mechanics, minimizing downtime and enhancing efficiency.
3. Mobility and Accessibility: Design a mobile workstation that can navigate diverse environments and provide access to all areas of vehicles for thorough inspections and repairs.
4. Safety and Ergonomics: Prioritize safety features and ergonomic design elements to minimize the risk of accidents and injuries for mechanics.
5. Quality of Service: Focus on enhancing the quality of repairs and customer experience by implementing standardized procedures.
6. Durability and Sustainability: Select materials and manufacturing methods that ensure durability, longevity, and environmental sustainability of the workstation.
7. Scalability and Adaptability: Design a workstation that can adapt to varying work environments and scale with the growth of the business.
8. Cost-Effectiveness: Balance innovative features with cost considerations to ensure affordability for auto repair businesses of all sizes.
9. Modular Design: Implement a modular design approach that allows for easy customization and adaptation to different vehicle types, repair tasks, and workspace configurations.
10. Environmental Impact: Incorporate eco-friendly materials and manufacturing processes to minimize the environmental footprint of the workstation.

Each of the key guidelines for design emerges logically from the research and analysis of the mobile auto mechanic industry. By identifying the most pressing challenges and opportunities for improvement, it prioritizes design elements that address these issues effectively, ultimately leading to a more innovative, functional, and successful solution.

Auto Mechanic Accessibility Eve Mills

Chapter 4 - Design Development

4.1 Initial Idea Generation

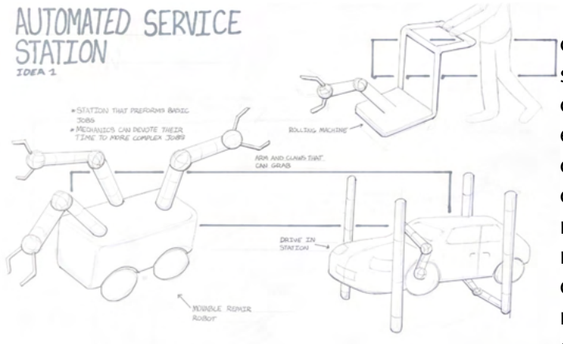
The concept of a mobile auto mechanic unit stems from the recognition of the convenience and efficiency it could bring to the automotive service industry. By offering on-the-go repair and maintenance services, a mobile unit eliminates the need for customers to travel to a fixed location, addressing the common challenge of accessibility. This innovative approach not only saves customers time and effort but also caters to those facing distance-related constraints in reaching traditional auto shops. Additionally, a mobile unit provides flexibility for mechanics, allowing them to reach clients at various locations promptly. The idea capitalizes on the modern lifestyle's demand for convenience, potentially transforming the way auto services are delivered and experienced.

4.1.1 Aesthetic Approach & Semantic Profile

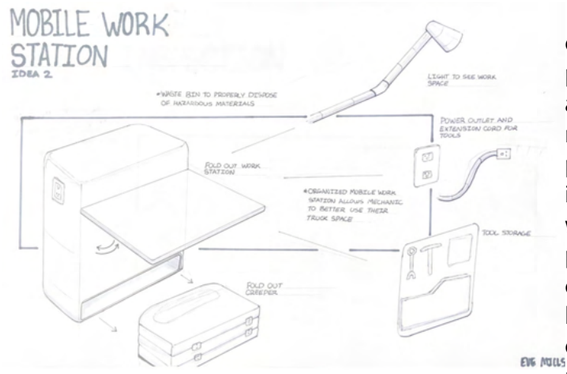
Drawing inspiration from various sources such as existing mechanic tool as well as unrelated ergonomic forms, this that resonates with users is created. Simultaneously, in the realm of mechanical products, efficiency is integrated as part of a compact design with the durability of a rugged design language. This fusion optimizes space, ensuring robust performance aligned with industry standards. The compact design emphasizes efficiency and portability, meeting practical user needs, while the rugged language ensures resilience in challenging auto mechanics environments. This design strives to offer a versatile, reliable solution, harmonizing the benefits of compactness with the durability crucial in mechanical product designs.

4.1.2 Mind Mapping

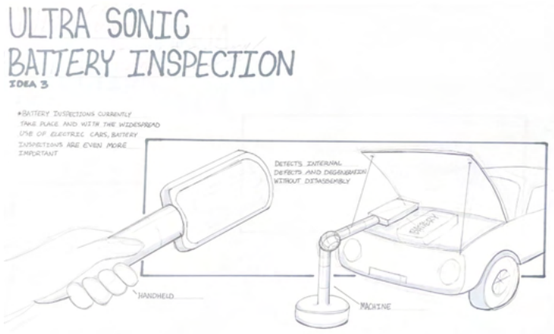
4.1.3 Ideation Sketches



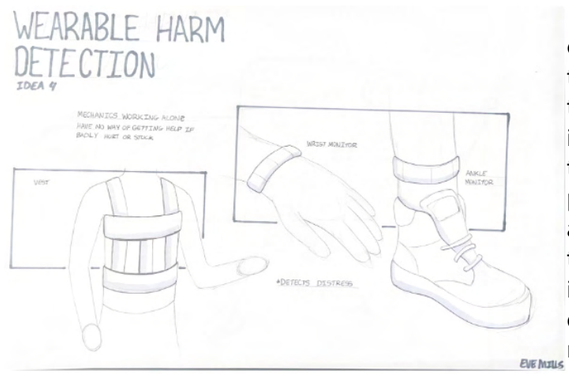
Mechanics often encounter situations where customers request additional services while in the shop for a specific task. Introducing a machine capable of handling routine mechanics duties empowers mechanics to focus on more critical tasks, optimizing their time and potentially expediting the overall service process. This efficiency could lead to a reduction in service costs, benefitting both mechanics and customers. Moreover, the deployment of such a machine could extend routine services to individuals residing in rural areas, overcoming geographical limitations and enhancing accessibility to essential automotive maintenance. This innovative approach not only streamlines service delivery in urban settings but also addresses the needs of those in more remote locations.

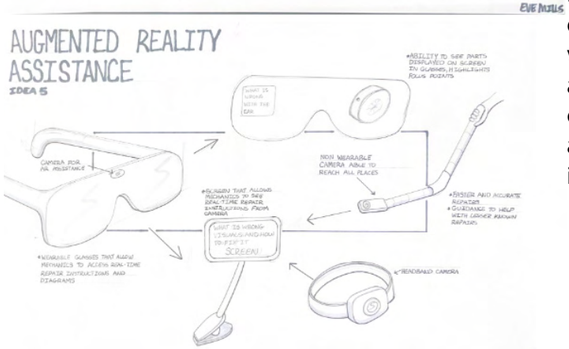


The mobile auto mechanic industry experienced significant growth during the pandemic, highlighting the demand for convenient automotive services. However, the effectiveness of mobile mechanics is hindered by the absence of proper equipment. To foster further growth in this industry, it is crucial to equip mobile auto mechanics with the necessary tools. Providing them with the proper tools ensures that they can offer a comprehensive range of services, overcoming limitations imposed by the lack of equipment. This not only enhances the efficiency and effectiveness of mobile mechanics but also contributes to the industry's expansion, meeting the evolving needs of customers who seek convenience and flexibility in auto services.



As the electric vehicle industry surges forward, the importance of thorough battery inspections becomes increasingly evident. Presently, these inspections primarily rely on visual assessments, as dismantling the intricate components of the battery poses risks and complexities. The examination typically involves checking for rust and loose wires, but there is a notable gap in the ability to visualize the internal state of the battery. Addressing this limitation becomes imperative for ensuring the safety and functionality of electric vehicle batteries. Developing advanced inspection methods that provide a clear view of the battery's internal condition would not only enhance safety protocols but also contribute significantly to the overall maintenance and longevity of electric vehicles.

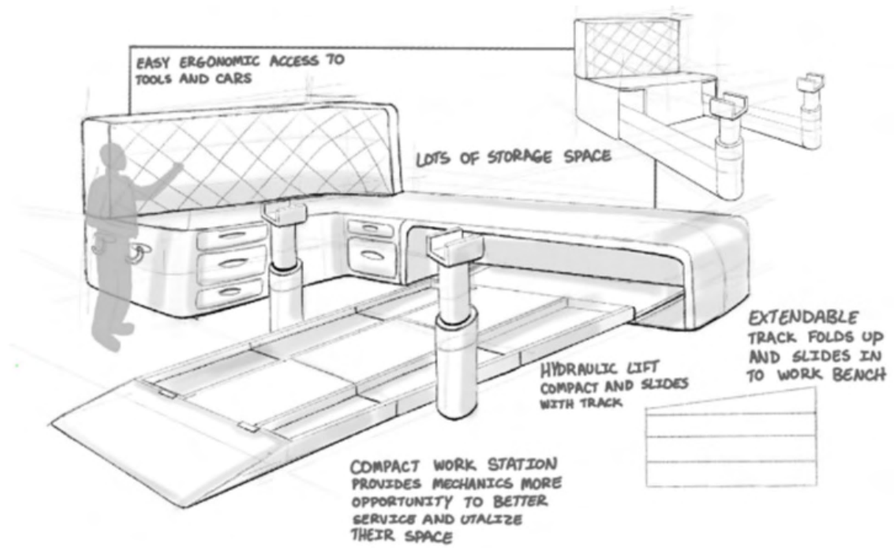


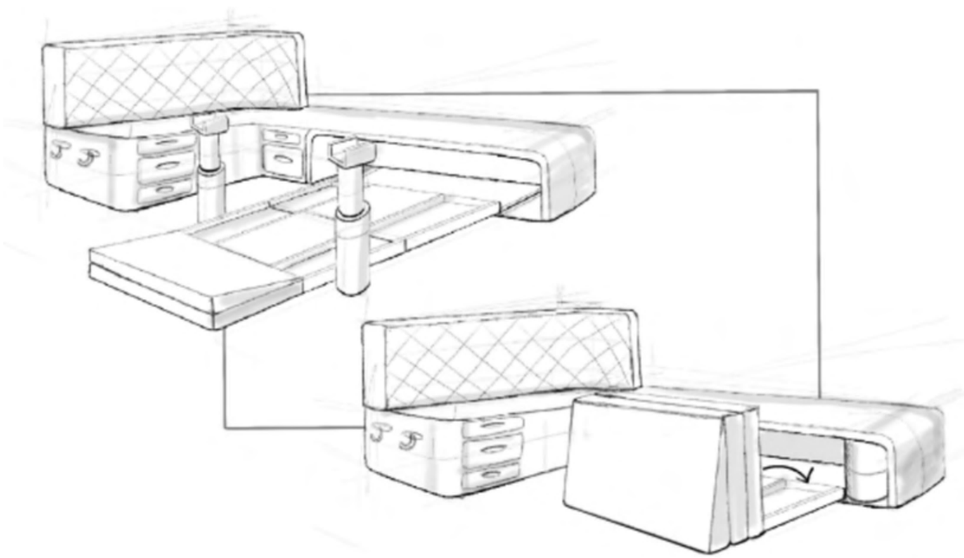


The communication gap between auto shop customers and mechanics can be addressed through the use of augmented reality (AR). By leveraging AR technology, customers can gain valuable insights into their vehicle's issues, fostering transparency and trust. Additionally, AR can empower mechanics by providing them with real-time, detailed information about specific car models and their manufacturing techniques. This is particularly crucial given the diverse information mechanics need to know, varying among different car companies. AR offers a universal tool for mechanics to access a broader range of knowledge, eliminating the need for specialization in a particular vehicle brand. Ultimately, the integration of augmented reality has the potential to enhance communication, build trust, and democratize automotive knowledge within the auto repair industry.

4.2 Concepts Exploration
4.2.1 Concept One

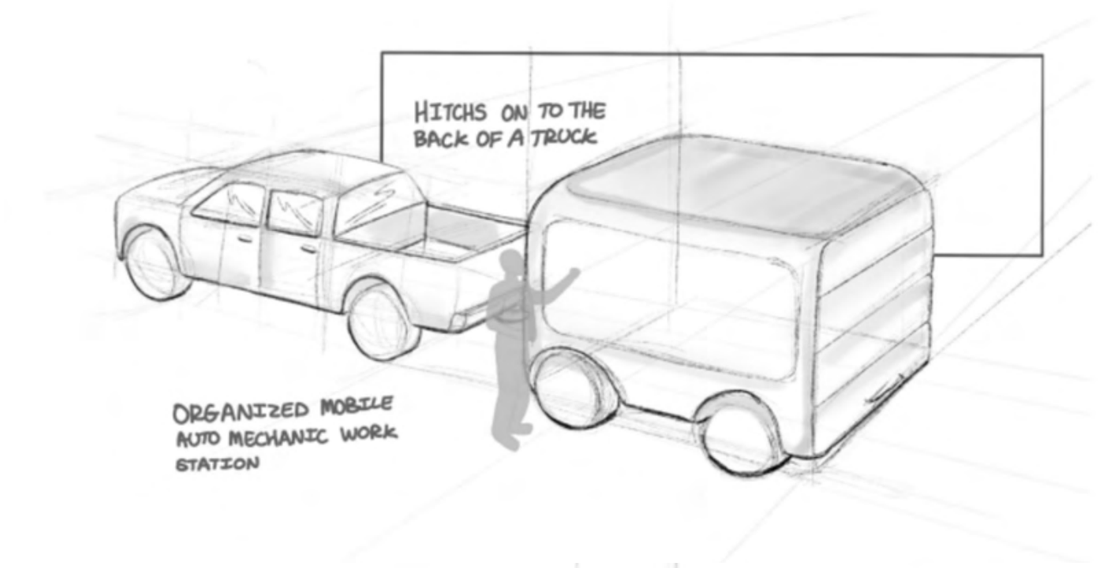
The first concept involves a static mechanic work station characterized by its compact design and heightened functionality. This iteration seeks to enhance the efficiency of traditional auto repair shops by introducing a compact and optimized workspace. The motivation behind this concept is to address the challenges faced by mechanics working in fixed locations, allowing them to operate more seamlessly and ergonomically. This aligns with the proposed thesis topic by delving into the improvement of conventional auto repair settings.

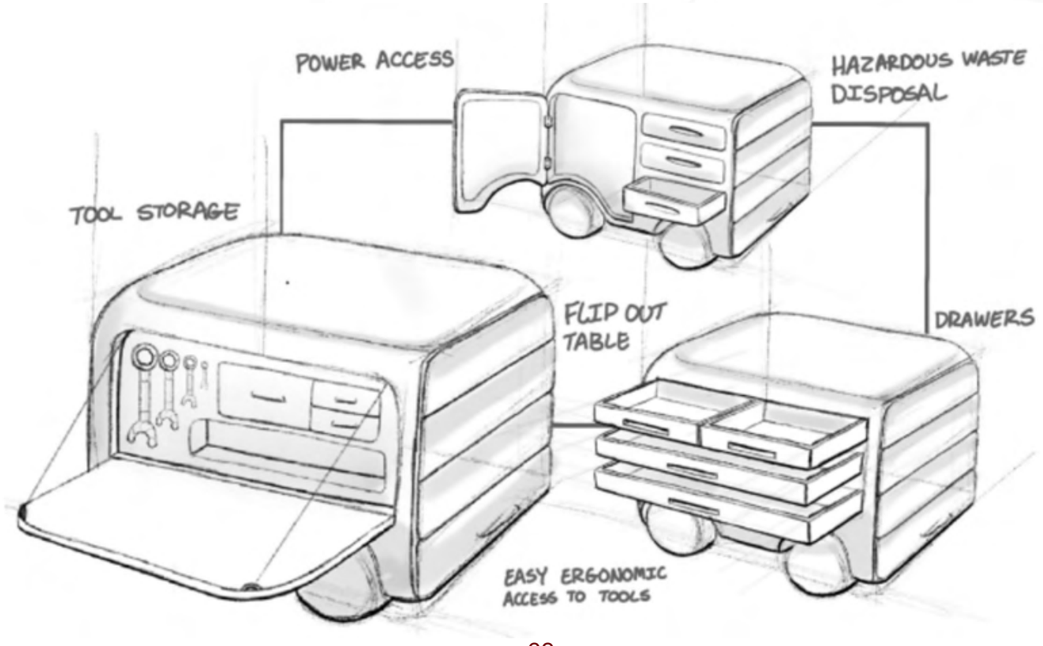


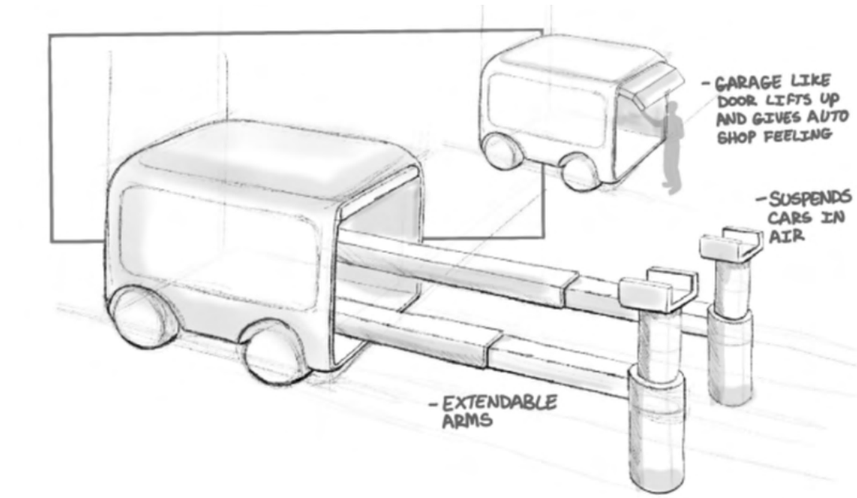


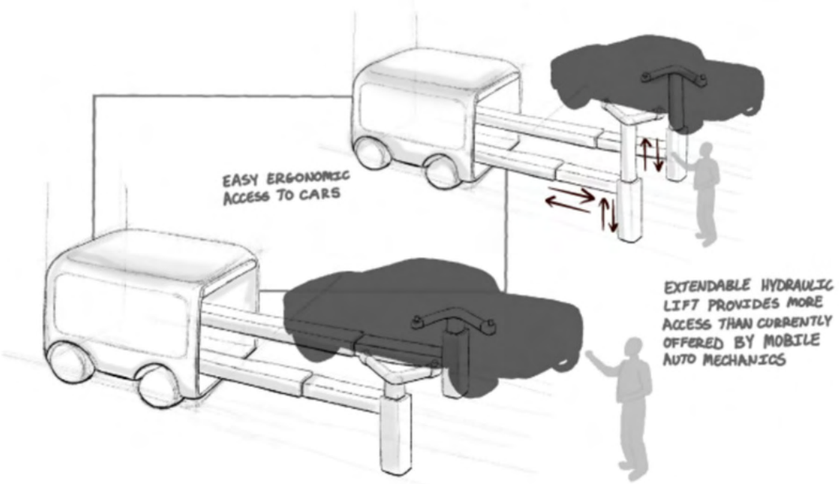
4.2.2 Concept Two

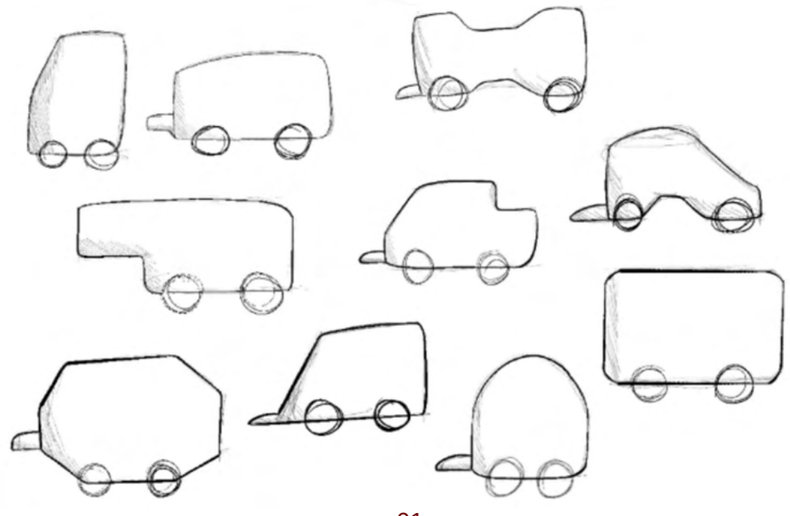
The second concept revolves around a mobile mechanic station. This mobile unit aims to provide on-the-go automotive services, catering to the growing demand for convenience and accessibility. The pursuit of this concept is grounded in the acknowledgment of the evolving trends in the automotive service industry, especially the rise of mobile auto mechanics. By offering a flexible solution that meets users where they are, this concept aligns with the proposed thesis topic, emphasizing the need for innovation in automotive service delivery.





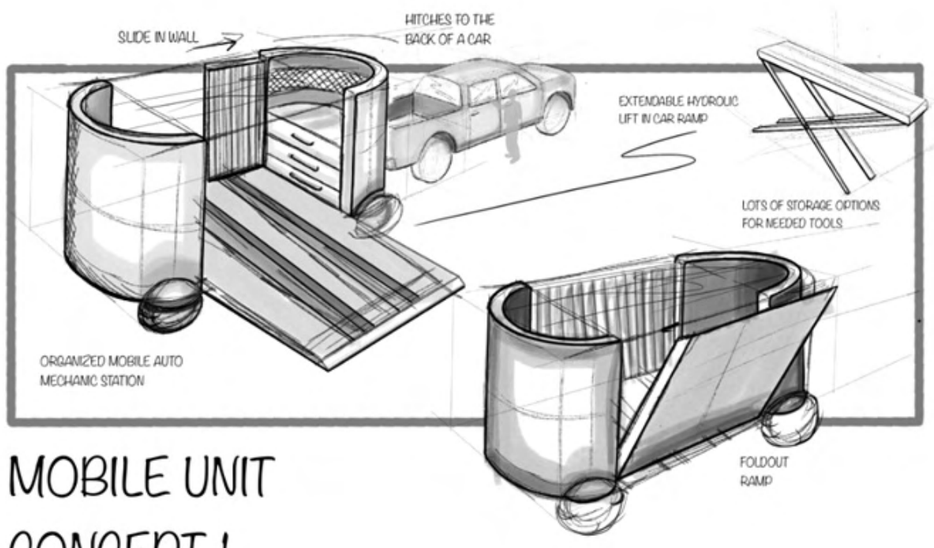




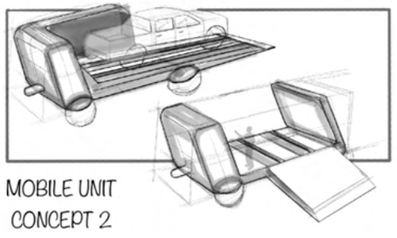


4.3 Concept Strategy
4.3.1 Concept Direction & Product Schematic One

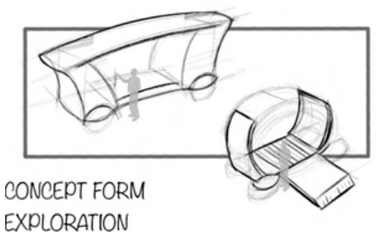
The decision to advance the mobile unit concept over the static mechanic workstation was grounded in the industry's response to evolving consumer preferences and emerging trends. Recognizing the increasing demand for convenient, on-the-go automotive services, the mobile unit aligns with the proposed thesis topic by prioritizing innovation and addressing the dynamic landscape of automotive service delivery. The mobile unit offers flexibility, accessibility, and enhanced user experience, meeting customers where they are and catering to changing lifestyles. This strategic choice reflects a commitment to staying at the forefront of market trends, emphasizing the importance of adaptability and responsiveness to emerging consumer needs in the automotive service industry.



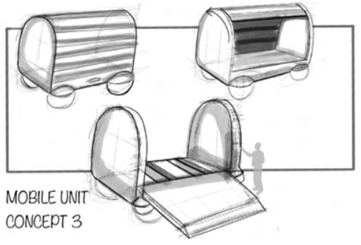
MOBILE UNIT CONCEPT 1



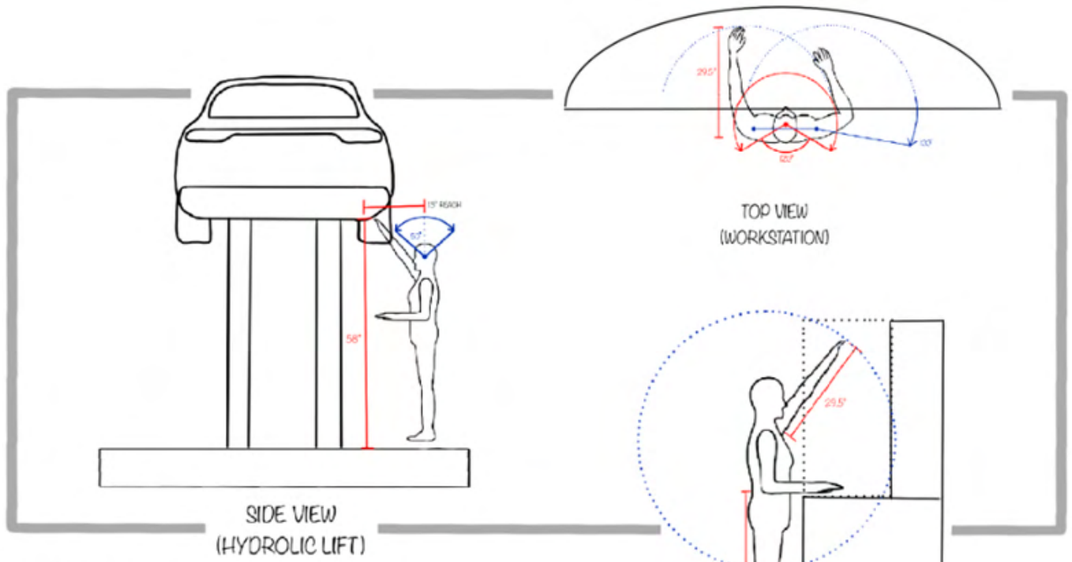
MOBILE UNIT CONCEPT 2



CONCEPT FORM EXPLORATION

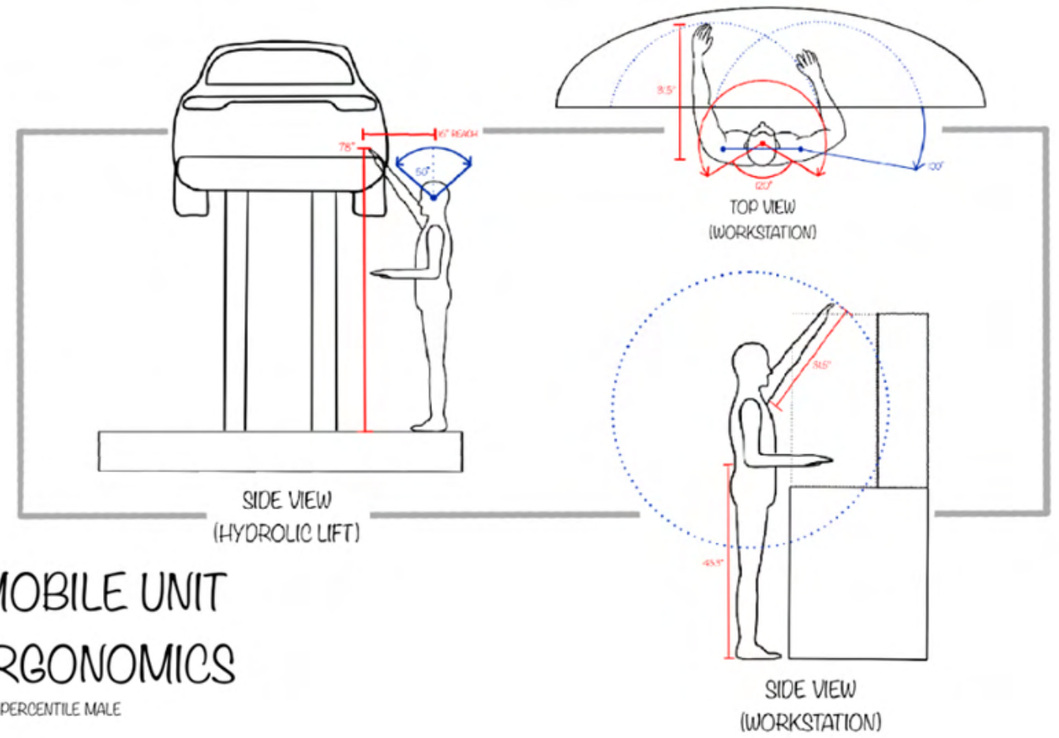


MOBILE UNIT CONCEPT 3



MOBILE UNIT ERGONOMICS

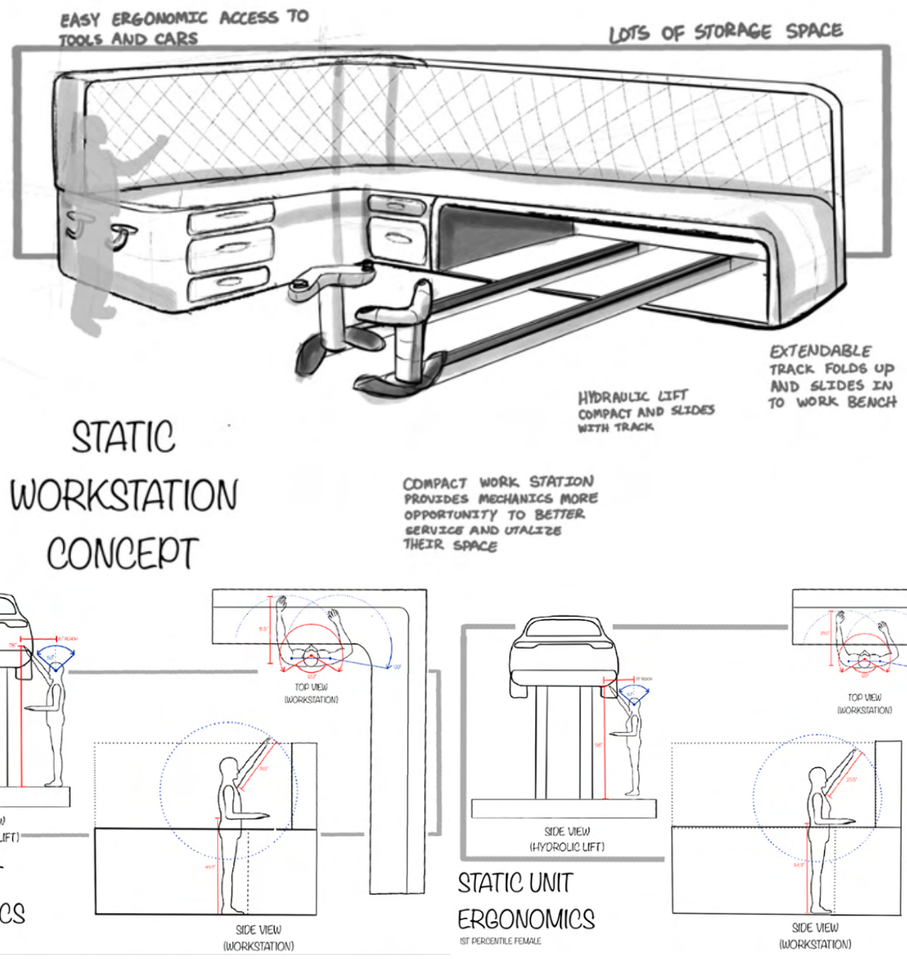
1ST PERCENTILE FEMALE



MOBILE UNIT ERGONOMICS

99th PERCENTILE MALE

4.3.2 Concept Direction & Product Schematic Two

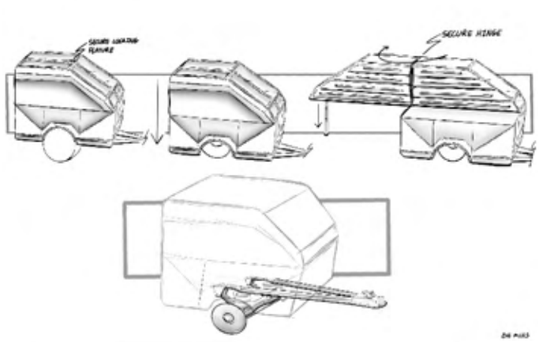


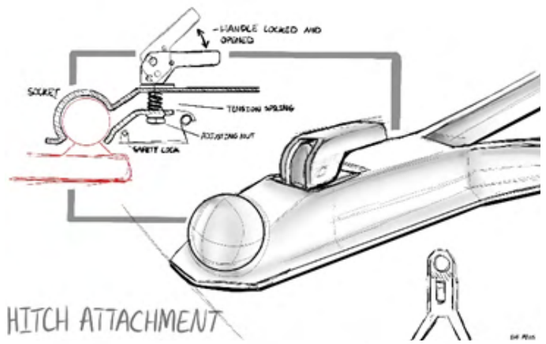
4.4 Concept Refinement & Validation

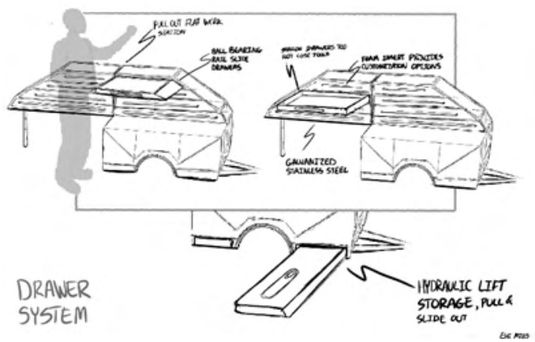
The selected design direction includes the mobile unit seen in concept direction 1 but with a more compact and functional design.

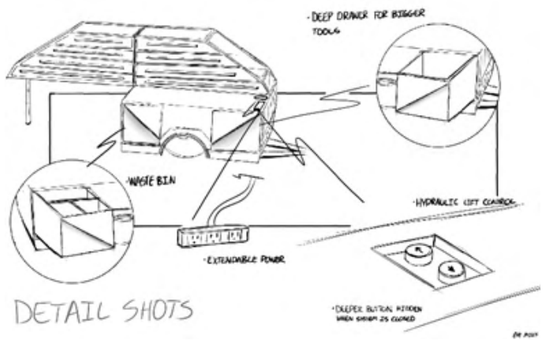
4.4.1 & 4.4.2 Design Refinement & Detail Development

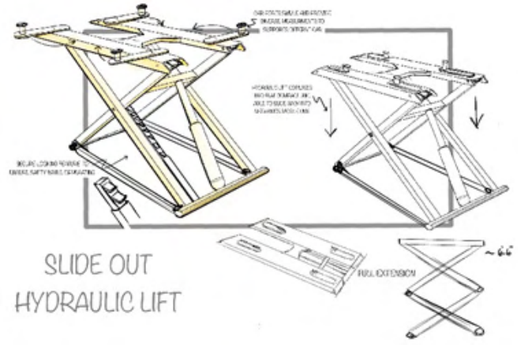
The refined concept introduces a compact mobile unit designed to meet the diverse needs of automotive mechanics with efficiency and versatility. Despite its small footprint, the unit holds ample storage capacity for tools and equipment, ensuring easy access during repairs. Its adjustable height feature allows for customization, promoting ergonomic comfort during extended use. Integrated with a pull-out hydraulic lift, mechanics can effortlessly elevate vehicles for thorough inspections and repairs. Convenient access ports for power and hydraulic controls speed up operations, minimizing downtime. Additionally, the inclusion of a safe waste bin ensures proper disposal of hazardous materials, maintaining a clean and compliant workspace. In sum, this compact mobile unit offers a comprehensive solution that prioritizes functionality, safety, and efficiency for automotive repair tasks.



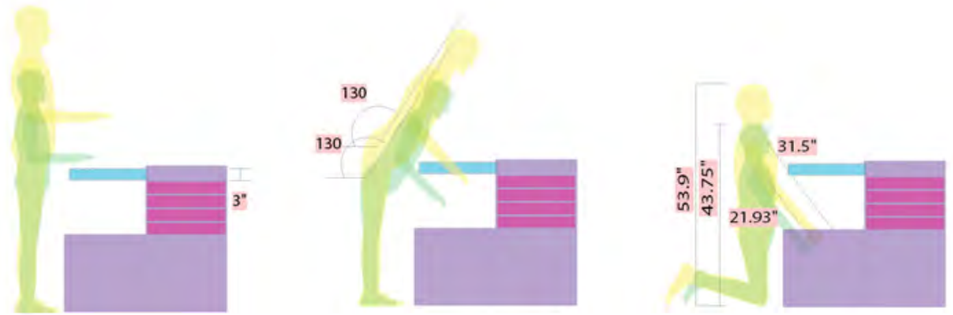








4.4.3 Refined Product Schematic & Key Ergonomic

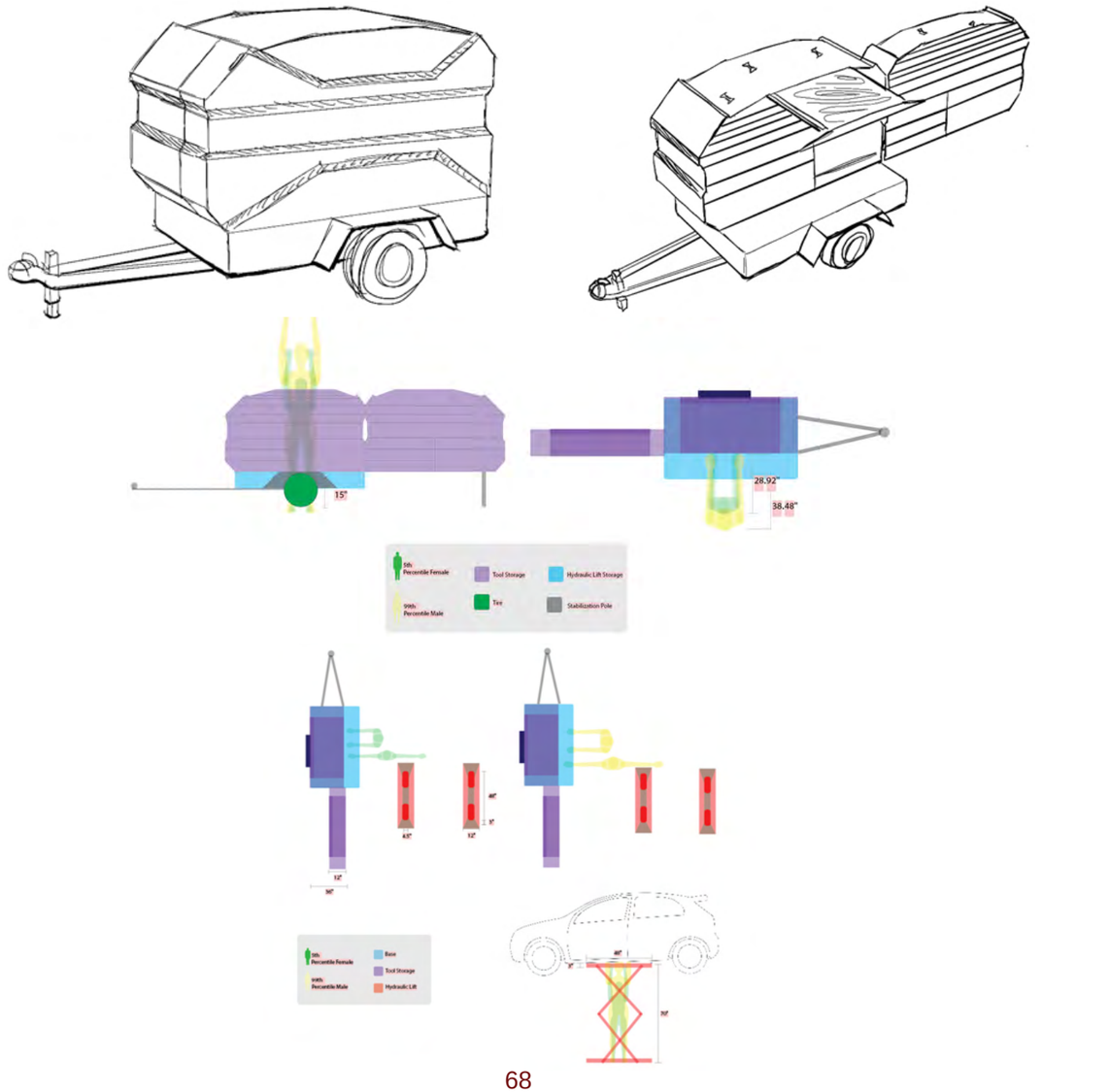


4.5 Concept Realization

This section will showcase the finalization of the design before progressing to CAD and 3D Modeling.

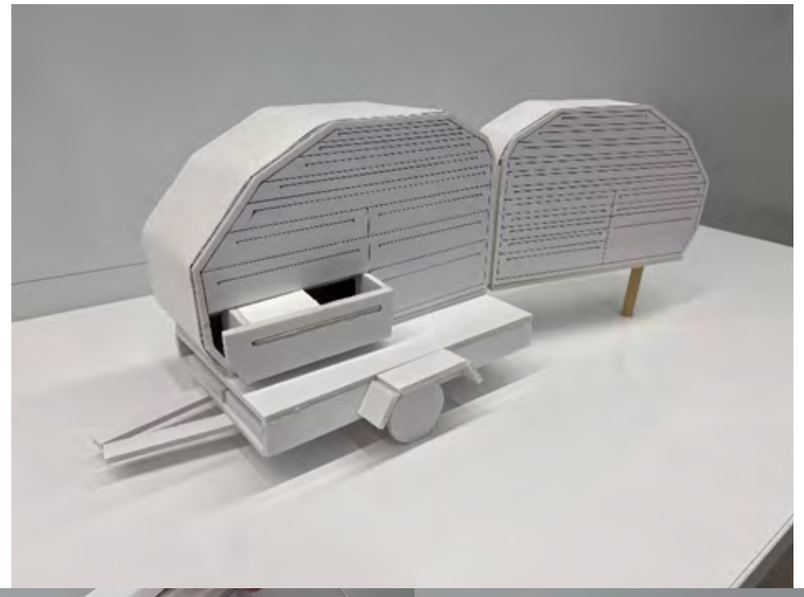
4.5.1 Design Finalization

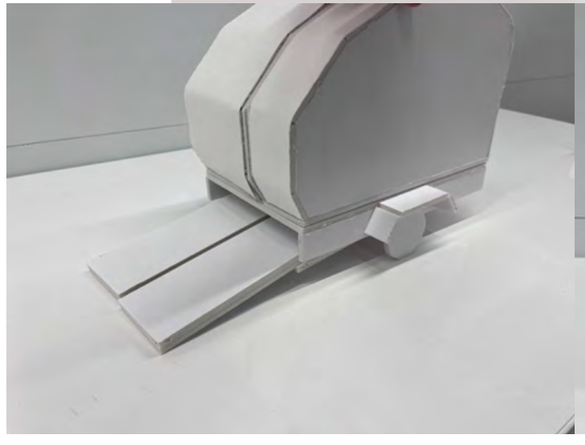
The overall design has been refined to be more compact and ergonomic, eliminating the need for the auto mechanic to bend or reach. This finalization maintains the functionalities previously mentioned while placing a greater emphasis on the aesthetics of the unit.

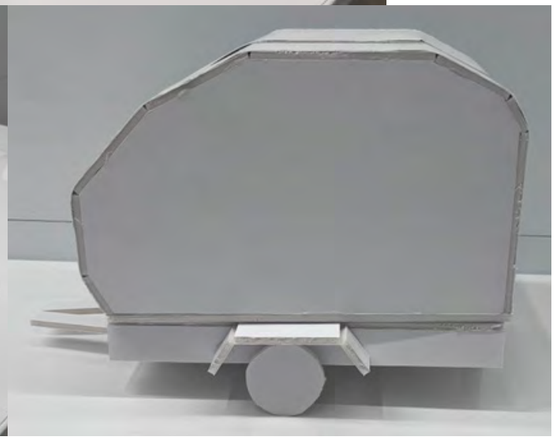


4.5.2 Physical Study Model

The importance of this physical scaled model in the design process cannot be overstated. This model served as an invaluable tool for the design process to assess and refine the near final concept before moving into 3D CAD modeling and physical scaled modeling. By creating a physical representation of the almost finalized design this helped understand how everything fit together and what needed to be changed. Through this physical study of a 1/6th scaled model, it was determined that the storage compartment for the hydraulic lift could be slightly reduced in size, and the wheels could be bigger, resulting in a more compact overall unit.





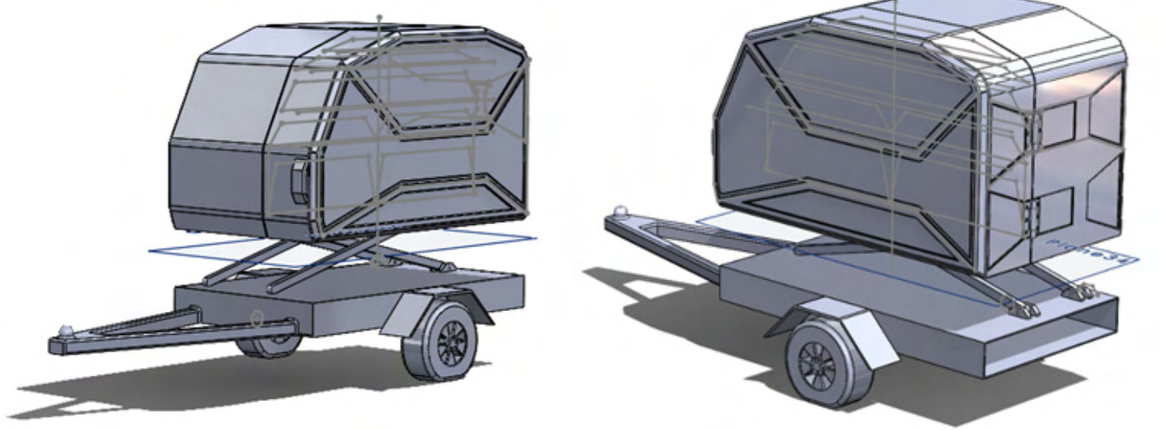


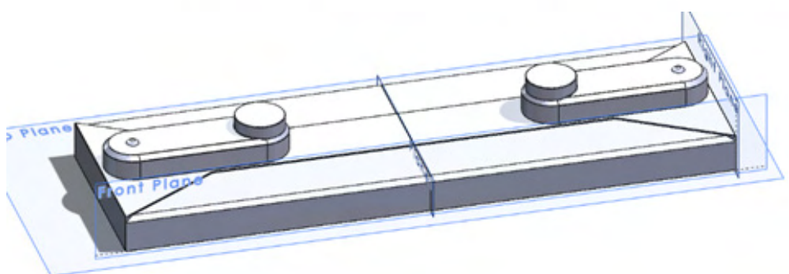
4.6 Design Resolution

Considerable attention was devoted to optimizing the drawer space within the mobile auto mechanic unit to accommodate essential components such as batteries and hydraulic controls. Careful measurements were taken to ensure that each drawer provided adequate room for these components to fit securely while still allowing for easy access when needed. Moreover, thoughtful consideration was given to how weight was distributed throughout the unit to maintain stability and ensure smooth driving. By strategically placing heavier items closer to the unit's center of gravity and dispersing weight evenly, the design aims to enhance maneuverability and minimize the risk of imbalance during transportation. This meticulous approach not only maximizes storage efficiency but also contributes to the overall functionality and safety of the mobile auto mechanic unit.

During this phase, careful consideration was given to the selection of materials for the mobile auto mechanic unit, with a majority of metal being chosen to construct the unit. This decision was driven by the need for durability, strength, and resistance to wear and tear, ensuring that the unit can withstand the rigors of daily use in various environments. Additionally, metal offers the advantage of being easily customizable and compatible with welding and fabrication techniques, allowing for precise construction and integration of components. By opting for metal as the primary material, the design team aims to enhance the longevity and reliability of the unit, ultimately maximizing its performance and value for the end user.

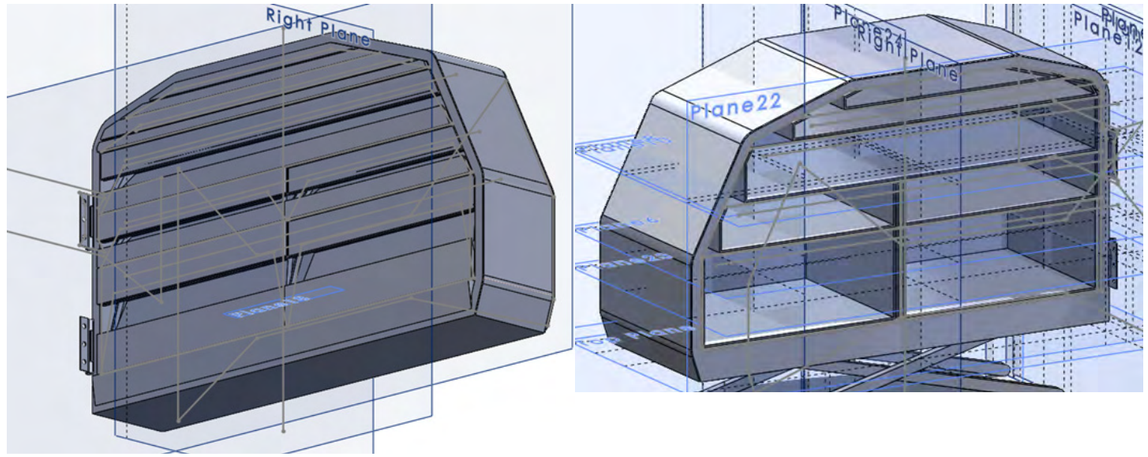
Below is the initial CAD that furthered the aesthetic design.

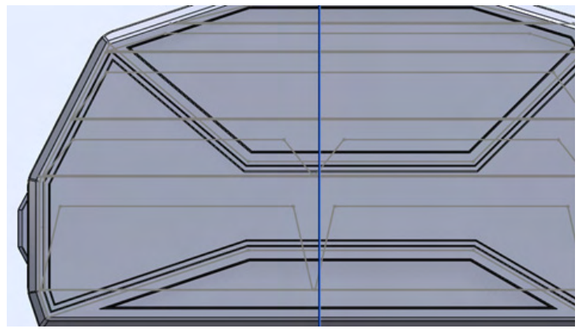


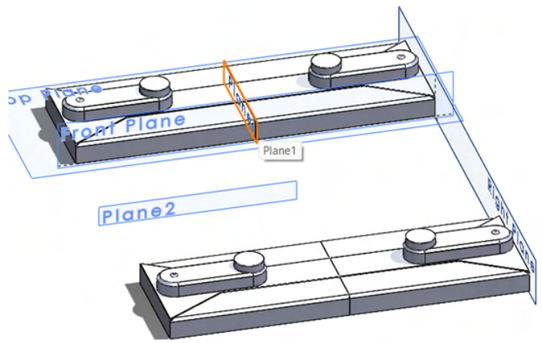


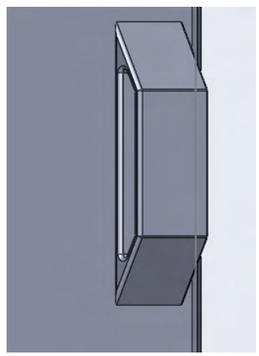
4.7 CAD Development

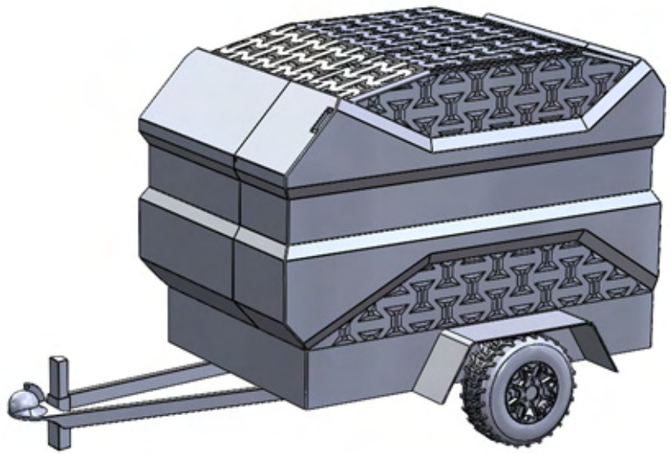
The CAD development phase was executed using SolidWorks software. Leveraging SolidWorks, the model underwent meticulous exploration and refinement, focusing on spatial arrangements, structural integrity, and aesthetic considerations. The CAD process initially focused on modeling the main unit to scale, ensuring seamless integration of its components. Following this, separate hydraulic components were developed. Finally, the models were scaled down for 3D printing, maintaining their integrity and functionality throughout the process.

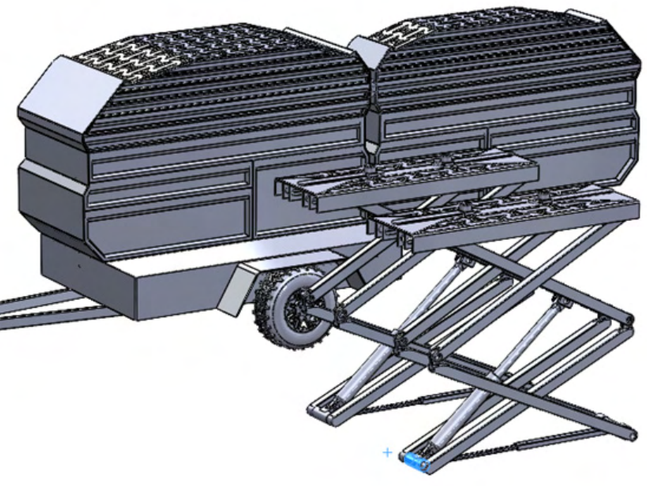


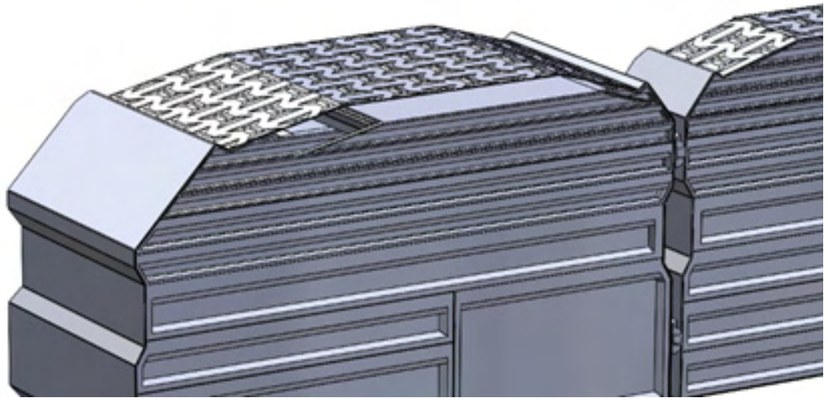






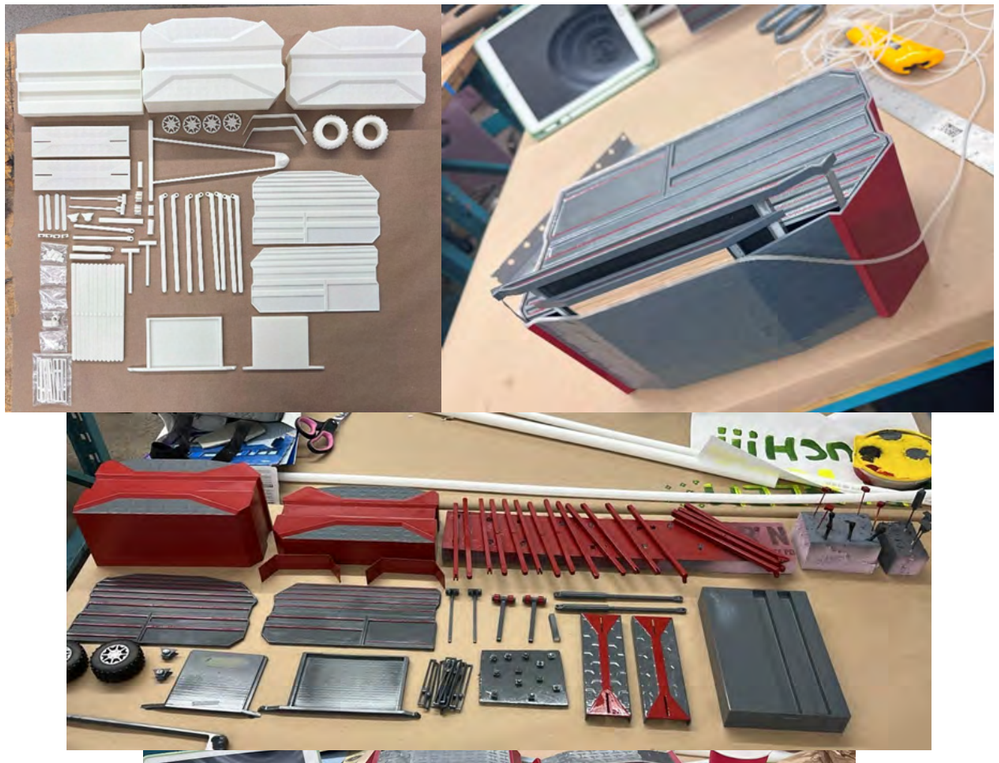






4.8 Physical Model Fabrication

Following the completion of CAD modeling, the model was printed in high-quality resin at a 1/6th scale. Every part underwent sanding to achieve a smooth surface suitable for painting. Subsequently, all components received a coat of grey primer. To achieve the desired finish, each part was carefully taped off and spray painted with its corresponding color. This meticulous process ensured the creation of a detailed and accurately colored representation of the mobile auto mechanic unit. Once painted additional details that were outsourced were added.



Chapter 5 - Final Design

5.1 Design Summery

Description:

MechXPress has a compact yet robust layout, meticulously designed to optimize every inch of space with ergonomic principles in mind. Its intuitive design ensures mechanics can access tools and equipment seamlessly, minimizing unnecessary bending or reaching. With strategic placement of drawers, compartments, and work surfaces, MechXPress addresses critical areas lacking in mobile auto repair services. These include an optimized workspace promoting ease of movement, comprehensive tool accessibility to minimize downtime, and mobility features enabling navigation of diverse environments for thorough inspections and repairs. Safety and ergonomics are prioritized to mitigate risks for mechanics, while standardized procedures enhance the quality of service. The workstation is built for durability and sustainability, incorporating eco-friendly materials and scalable design elements to adapt to varying work environments and business growth. Balancing innovative features with cost considerations ensures affordability, while a modular design approach allows for easy customization and adaptation to different vehicle types and repair tasks. Ultimately, MechXPress emerges as a logical solution born from thorough research and analysis, aiming to minimize environmental impact and revolutionize the mobile auto repair industry.

Explanation:

The design process began with a thorough analysis of user needs, industry trends, and technological advancements. Through iterative prototyping and testing, various layout configurations were explored to find the optimal balance between functionality, ergonomics, and aesthetics. The final design integrates feedback from mechanics, stakeholders, and experts in the field to ensure that every aspect meets the highest standards of performance and usability. Special attention was given to the arrangement of hydraulic controls, tool storage, and workspace layout to streamline operations and enhance efficiency. Additionally, advanced materials and manufacturing techniques were employed to ensure durability, reliability, and longevity of the unit under demanding working conditions.

Benefit Statement:

The mobile auto mechanic unit offers numerous benefits to both mechanics and customers alike. Firstly, its compact and ergonomic design reduces strain and fatigue on mechanics, allowing them to work more comfortably and efficiently for extended periods. This not only improves job satisfaction but also enhances productivity and reduces the risk of work-related injuries. Secondly, the unit's mobility enables mechanics to bring their services directly to customers' locations, eliminating the need for customers to transport their vehicles to traditional garages. This not only saves time and effort but also provides greater convenience and accessibility, especially for individuals with busy schedules or limited mobility. Lastly, the cost-effective nature of mobile auto repair services, coupled with the unit's efficient design, results in lower overhead costs and ultimately translates to savings for both mechanics and customers. Overall, the mobile auto mechanic unit represents a transformative solution that revolutionizes the automotive repair industry by combining innovation, efficiency, and convenience.

5.2 Design Criteria Met

5.2.1 Full Bodied Interaction Design

The design of MechXPress meets the selected criteria for full-bodied interaction in several key ways. MechXPress features a compact yet robust layout that optimizes workspace utilization, enabling mechanics to move freely and access tools effortlessly. This design promotes efficient interaction with the workstation. To access tools, users simply need to grab the comfortable drawer handles. Additionally, when adjusting the unit to meet their personal requirements, they can use the ergonomically comfortable remote control.

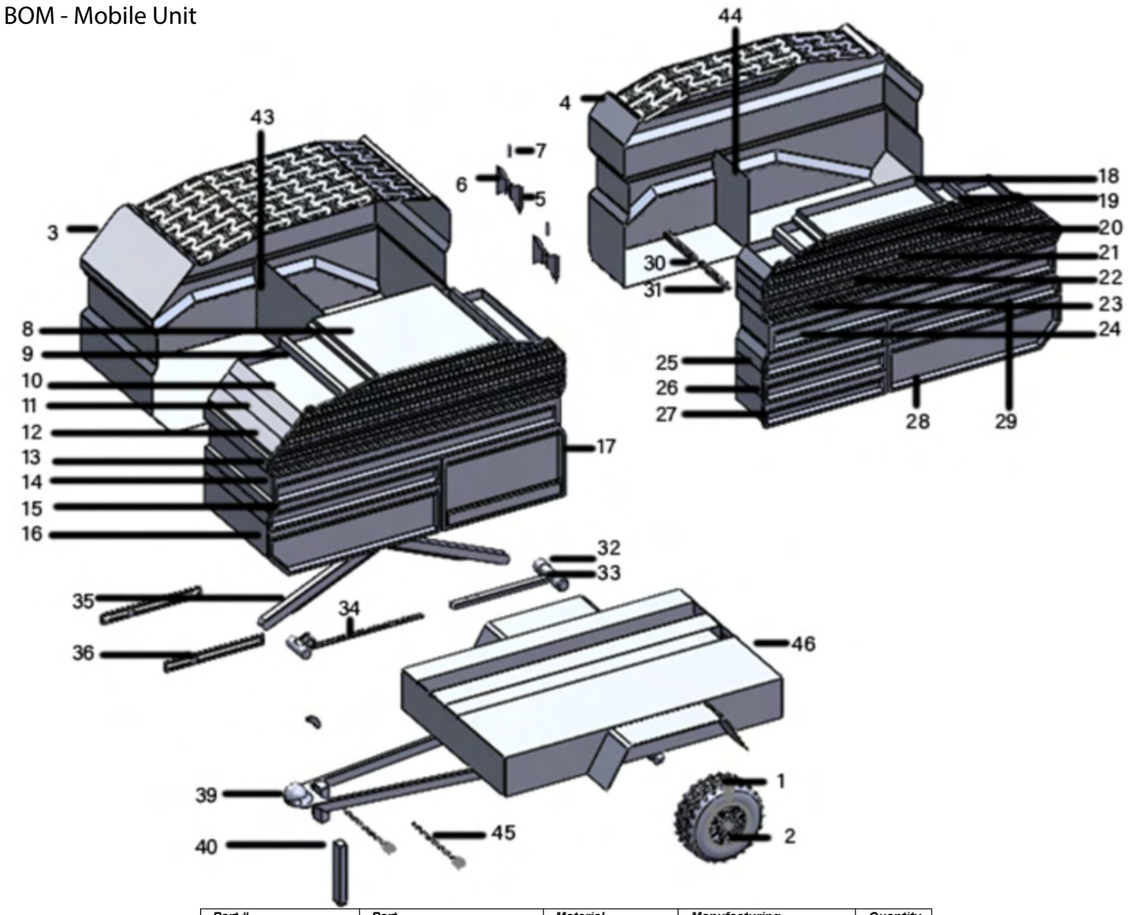
5.2.2 Materials, Process, & Technology

Steel was chosen as the primary material for MechXPress due to its exceptional strength, durability, and versatility. Steel's high tensile strength ensures that the workstation can withstand the demands of heavy tools and equipment, while its durability guarantees long-term reliability. Additionally, steel's resistance to corrosion enhances workplace safety and longevity, making it the ideal choice for a robust and enduring mechanical workstation like MechXPress.

In manufacturing MechXPress, a combination of bending, spot welding, and bolts is employed, representing common methods for fabricating similar products. Bending shapes the steel components, providing strength and rigidity. Spot welding securely joins these components, ensuring structural integrity. Bolts reinforce critical connections and facilitate easy assembly and disassembly. This approach ensures MechXPress is robust, durable, and compliant with widely accepted industry standards.

5.2.3 Design Implementation

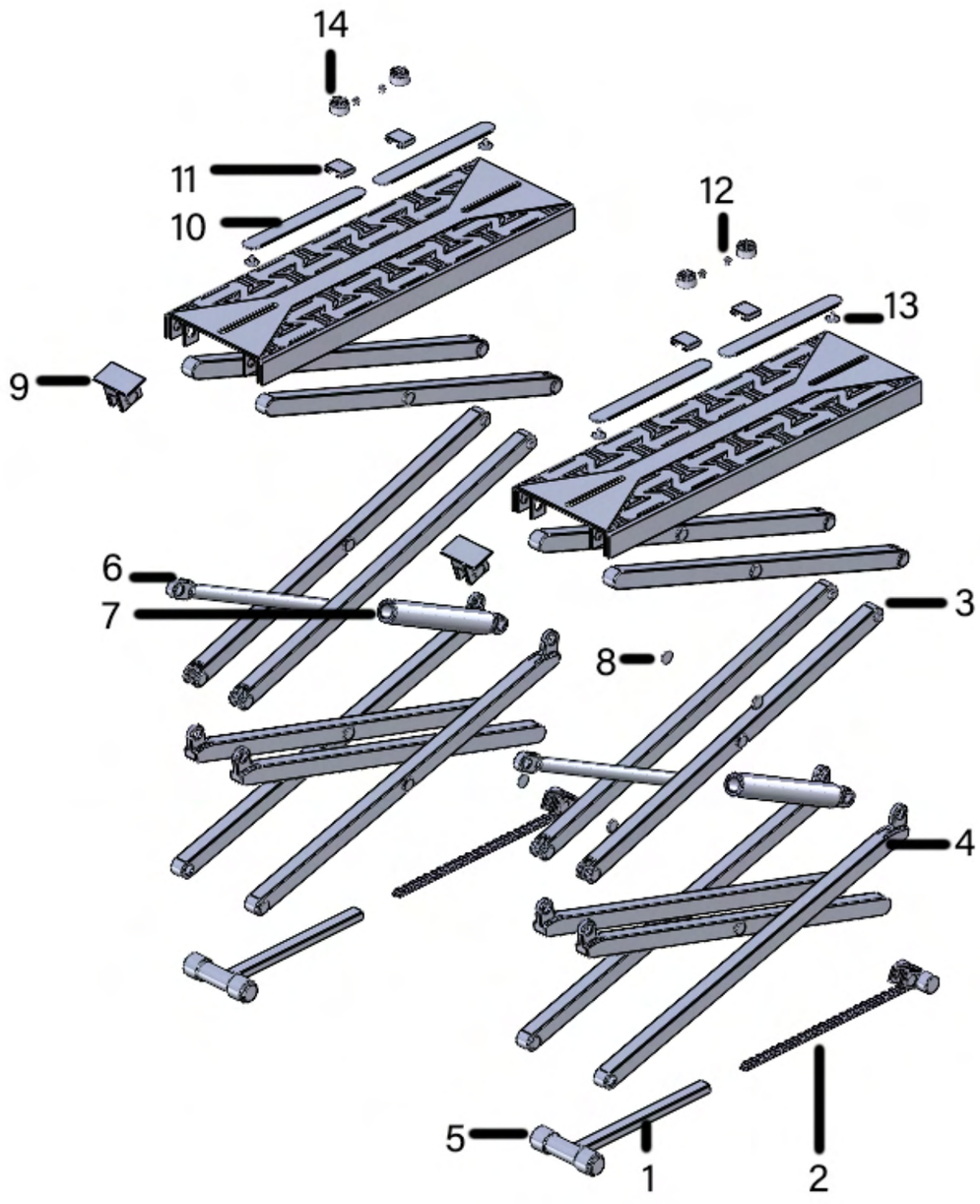
BOM - Mobile Unit



Part #	*Part*	*Material*	*Manufacturing*	*Quantity*
1	Tire	Rubber	Extrusion	2
2	Rim	Aluminum	Forged	2
3	Big Body	Steel	Metal forming, bending, & welding	1
4	Small Body	Steel	Metal forming, bending, & welding	1
5	HingeA	Steel	CNC	2
6	HingeB	Steel	CNC	2
7	Hinge Pole	Steel	CNC	2
8	DrawerA	Steel + Wood	Bending, & welding	1
9	DrawerB	Steel	Bending, & welding	1
10	DrawerC	Steel	Bending, & welding	1
11	DrawerD	Steel	Bending, & welding	1
12	DrawerE	Steel	Bending, & welding	1
13	DrawerF	Steel	Bending, & welding	1
14	DrawerG	Steel	Bending, & welding	1
15	DrawerH	Steel	Bending, & welding	1
16	DrawerI	Steel	Bending, & welding	1
17	DrawerJ	Steel	Bending, & welding	1
18	DrawerK	Steel	Bending, & welding	1
19	DrawerL	Steel	Bending, & welding	1
20	DrawerM	Steel	Bending, & welding	1
21	DrawerN	Steel	Bending, & welding	1
22	DrawerO	Steel	Bending, & welding	1
23	DrawerP	Steel	Bending, & welding	1
24	DrawerQ	Steel	Bending, & welding	1
25	DrawerR	Steel	Bending, & welding	1
26	DrawerS	Steel	Bending, & welding	1
27	DrawerT	Steel	Bending, & welding	1
28	DrawerU	Steel	Bending, & welding	1
29	DrawerV	Steel	Bending, & welding	1
30	Drawer RunnerA	Steel	Bending & Machining	48
31	Drawer RunnerB	Steel	Bending & Machining	48
32	Safety Wheel	Steel	Tube Forming	2
33	SafetyA	Steel	Die Cutting	1
34	SafetyB	Steel	Die Cutting	1
35	Lift Arm	Steel	Bending & Forming	4
36	Lift Slider	Steel	Die Cutting	4
37	Tail Light	Plastic	Injection Molding	2
38	Lift Support	Steel	Die Cutting	4
39	Hitch	Steel	Bending, Forming, & CNC	1
40	SupportA	Steel	Forged	1
41	SupportB	Steel	Forged	1
42	Screw	Steel	Thread rolling	16
43	Drawer SupportA	Steel	Lazer Cut	1
44	Drawer SupportB	Steel	Lazer Cut	1
45	Chain	Steel	Bending & Welding	2 Rows
46	Door	Steel	Bending, & welding	1

Auto Mechanic Accessibility Eve Mills

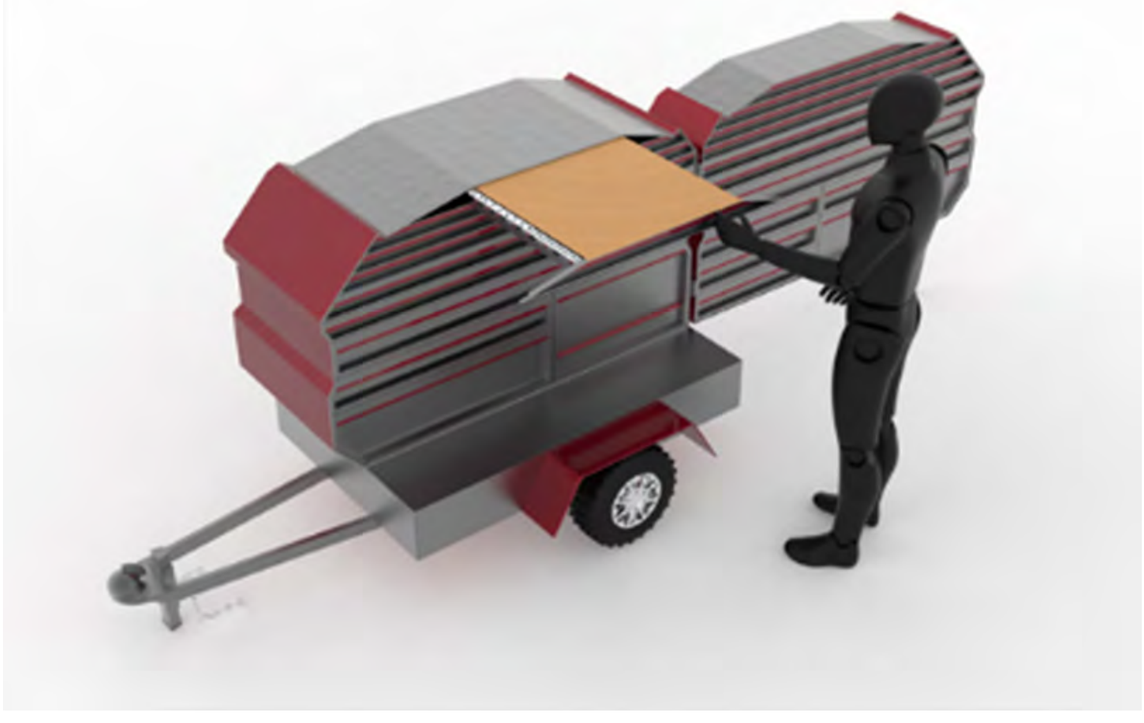
BOM - Hydraulic Lift



Auto Mechanic Accessibility Eve Mills

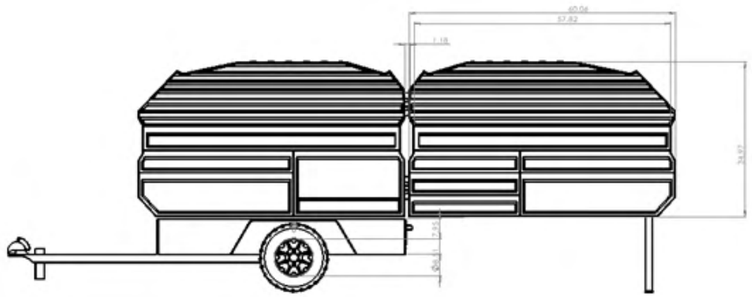
Part #	Part	Material	Manufacturing	Quantity
1	SafteyA	Steel	Die Cutting	2
2	SafteyB	Steel	Die Cutting	2
3	ArmA	Steel	Bending & Forming	8
4	ArmB	Steel	Bending & Forming	8
5	Safety Wheel	Steel	Tube Forming	4
6	PistonA	Steel	CNC	2
7	PistonB	Steel	CNC	2
8	Screw	Steel	CNC	40
9	Hinge	Steel	CNC	2
10	Top Arm	Steel	Lazer Cut	4
11	Slider	Steel	Bending	4
12	StopperA	Steel	CNC	2
13	StopperB	Steel	CNC	2
14	Port	Rubber	Molded	4

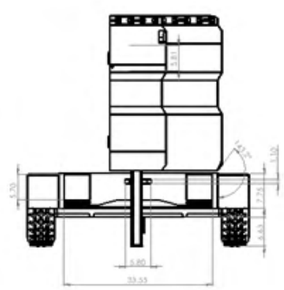
5.3 Final CAD Rendering

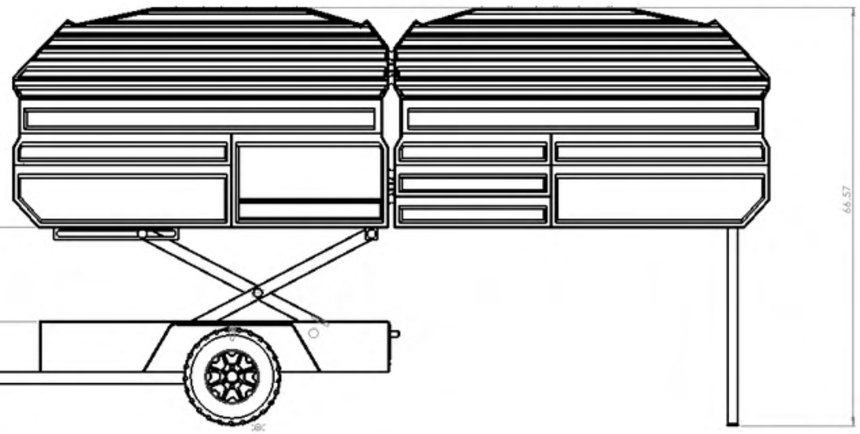


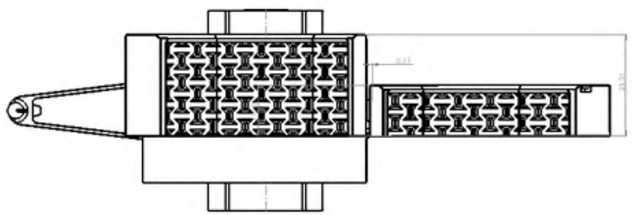
5.4 Physical Model

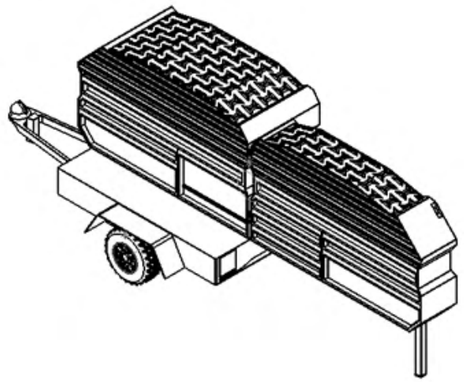
5.5 Technical Drawing

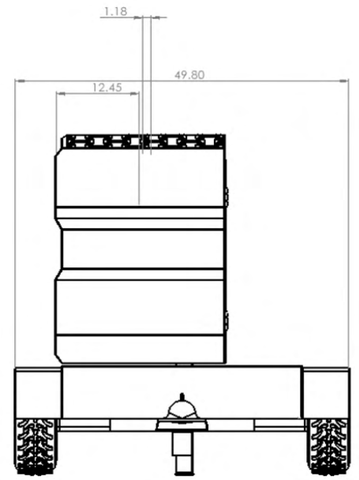


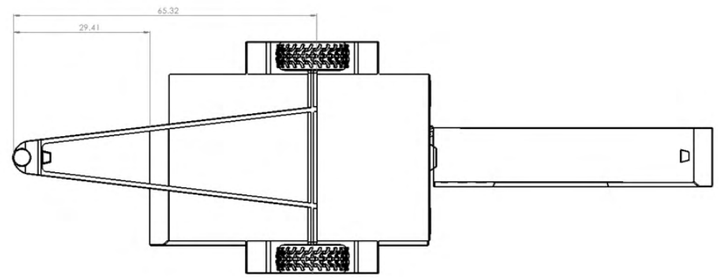


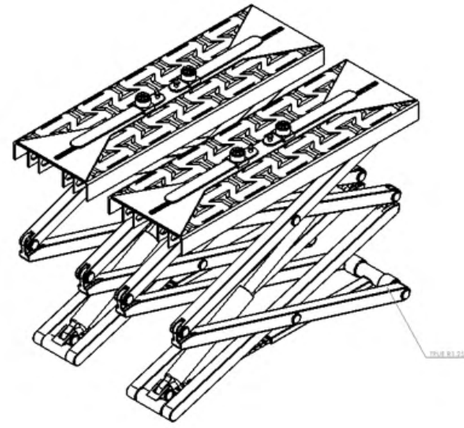


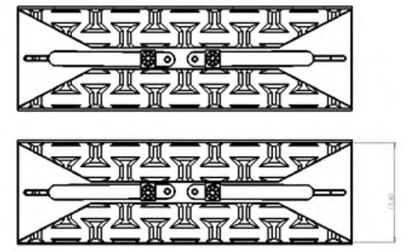


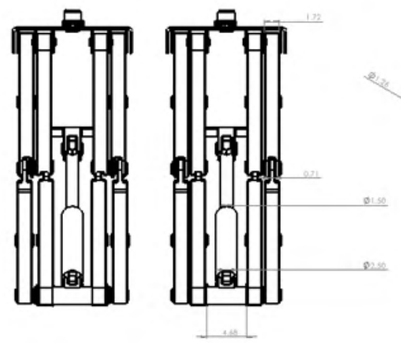


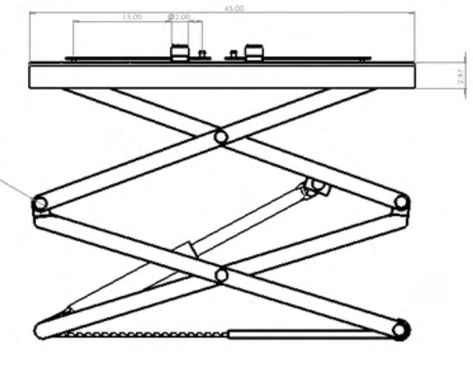












5.6 Sustainability

Durability is crucial for a mechanic workstation, ensuring a prolonged lifespan and promoting sustainability by minimizing the need for frequent replacements. The findings of this report highlights sustainability through a thoughtful selection of materials and manufacturing processes. Prioritizing functionality and durability, the choice of stainless steel as a primary material reflects sustainable commitment to 100% recyclability and long-lasting product performance. The exclusion of less sustainable options, such as certain steel types and environmentally unfriendly materials like silicone, highlights the dedication to responsible material resourcing.

The manufacturing approach aligns with sustainability, utilizing techniques such as metal bending, puncturing, and powder coating to ensure product longevity and contribute to waste reduction. Additionally, the design extends its sustainability focus to end-of-life considerations by incorporating recyclable materials like stainless steel.

Incorporating these sustainable materials and manufacturing methods aims to enhance and elevate the sustainability of the mechanic industry.

Chapter 6 Conclusion

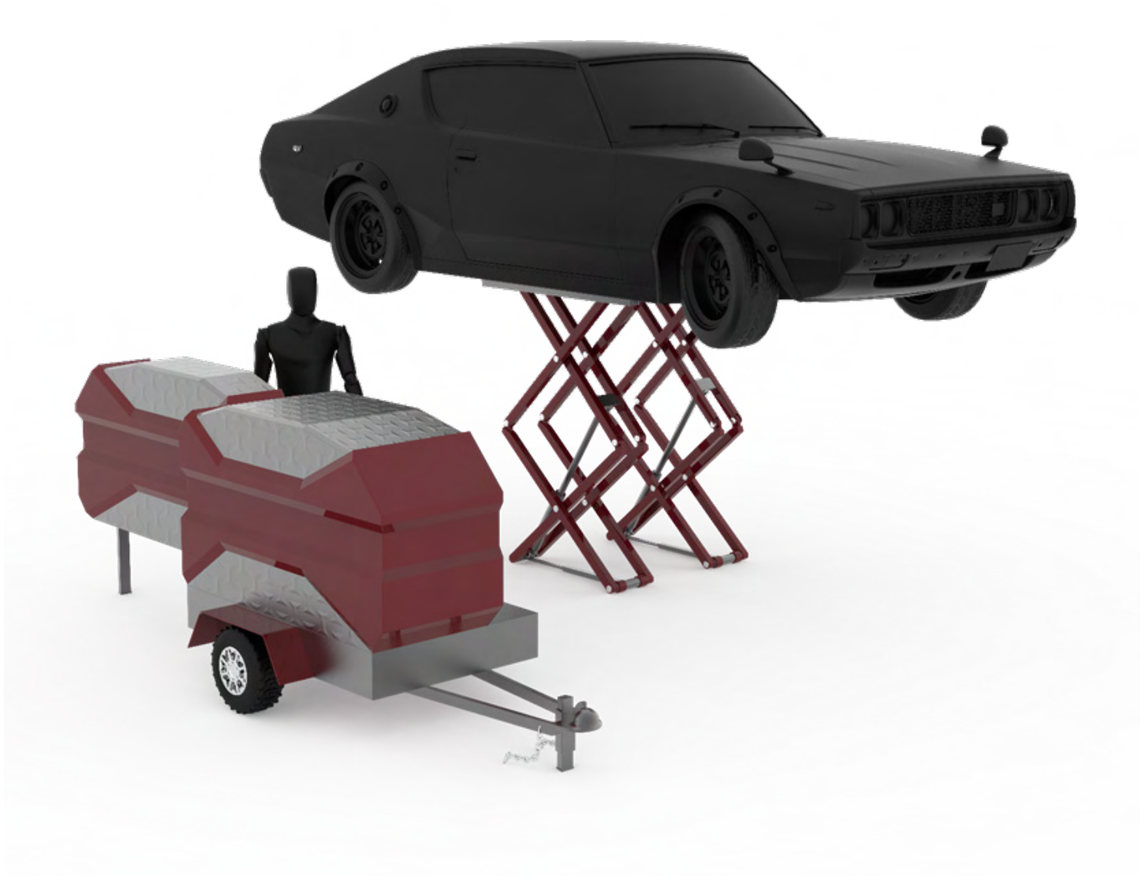
Chapter 6 Conclusion

The mobile automotive repair industry faces significant accessibility challenges, impacting individuals from diverse backgrounds and abilities. This multifaceted issue encompasses physical, financial, and educational accessibility barriers, hindering both customers and mechanics. Existing solutions often fall short in meeting the diverse needs of this user group, necessitating innovative approaches to bridge the accessibility gap.

This project's design approach prioritizes the creation of an automotive repair workstation that not only optimizes space utilization but also ensures seamless movement for mechanics. By strategically organizing tools and equipment, downtime is minimized, and repair processes are streamlined. The inclusion of a mobile workstation enhances accessibility, allowing mechanics to navigate diverse environments and access all areas of vehicles for thorough inspections and repairs. Safety features and ergonomic design elements are integrated to minimize the risk of accidents and injuries, fostering a secure working environment. Moreover, the design emphasizes durability and sustainability by selecting eco-friendly materials and manufacturing methods, ensuring longevity and minimizing environmental impact. Overall, the project's comprehensive design addresses key guidelines for optimizing automotive repair workspaces, enhancing efficiency, safety, and sustainability.

By embracing innovation and leveraging emerging technologies, the automotive repair industry can better meet the needs of both customers and professionals, ensuring a more equitable and sustainable future.

Auto Mechanic Accessibility Eve Mills



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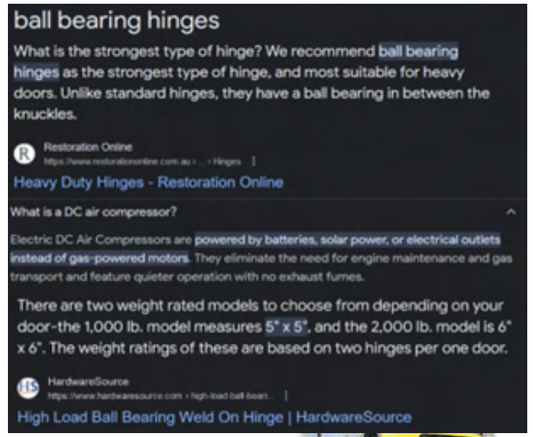
Appendix

Discovery
Contextual Research
Field Research
Result Analysis
BOM Info/Data
Sustainability Info/Data
Approval Forms and Plans
Advisor Meetings & Agreement Forms

Discovery

Contextual Research



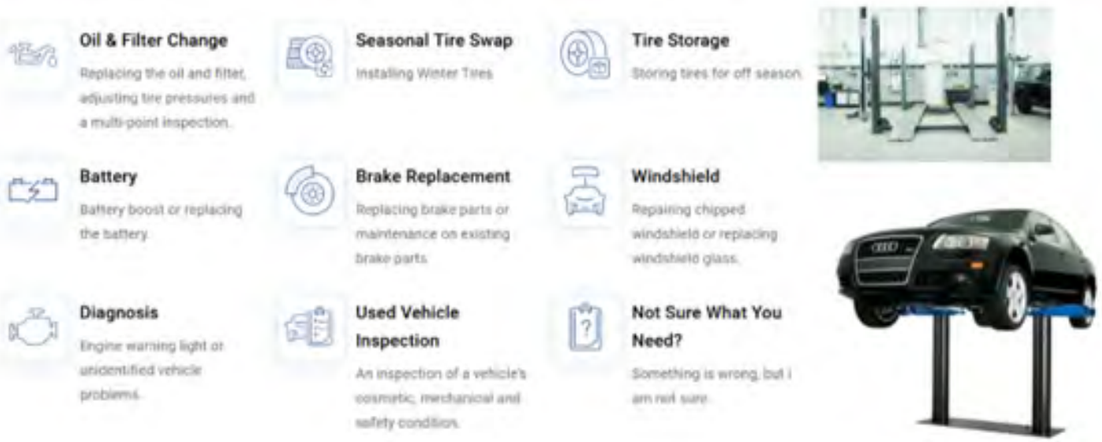
Current Market

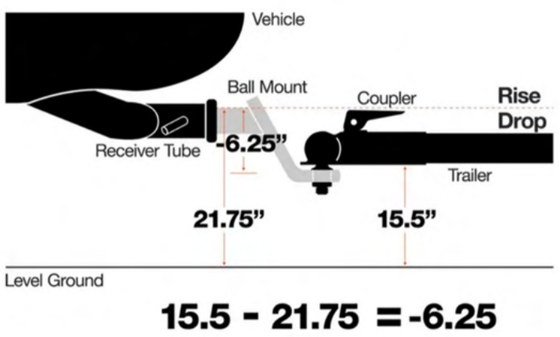
What are the most common services that customers come in for?

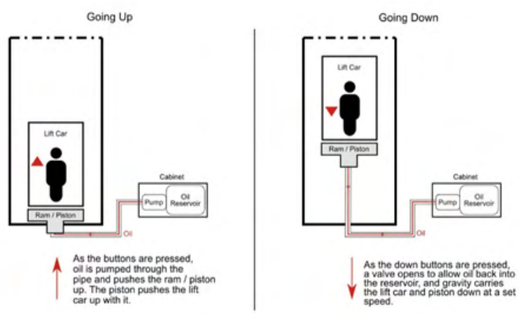
4 responses

- Diagnostics
- Oil change, tires, brakes, diagnostics
- Oil changes, scheduled services, tire change overs
- Regular maintenance, oil changes, coolant flushes, complaints of braking, fault codes or lights on dash

Product	Material	Price	Weight	Sustainability	Strength
	Polypropylene	$1,282.57	8.1 x 57.91 x 45.72 cm; 0.28 Grams	Relatively low carbon foot print but not fully sustainable	45.36 Kilograms
	Steel	$314	70lb	Sustainable since when steel is made once it can be used over and over again	300 LB
	Wood	$1,725	22 LB	Renewable & Recyclable	31 LB







Field Research

Product Name	Picture	Brand	Benefits	Features
Tool Bench		Craftsman	• Provides organised workspace for tools.	• Sturdy construction with multiple drawers and compartments. • The 3000 Series 63-in. Wide 8 Drawer Mobile workbench utilises an all steel I-Frame Double Wall Construction. Each drawer can support 120 lb. Features heavy-duty soft close drawer slides that gently pull themselves shut without slamming.
Creeper		Pro-Lift	• Enables mechanics to comfortably slide under vehicles.	• Padded surface for comfort. • Swivel casters for easy manoeuvrability. • Pro Lift C-2036D Creeper is a 2 in 1 creeper that is designed to be folded in a "Z" shape for use as a mechanics seat or unfolded for use as a mechanics creeper. • With tts thick padded bed, it gives you extra comfort while getting your job done. • Pro Lift C-2036D Creeper features 6 swivel casters. They provide users with the full mobility and ease of use to get under the tight area. • In addition, Pro Lift C-2036D Creepers are built with the heavy duty frame. It supports up to 300 lbs capacity. • - Low Profile Design and Folded to be "Z" Shape as Mechanic Seat
				- Six Swivel Casters for Mobility - Think Padded Cushions for extended Comfort - 300 lbs Load Capacity • Specifications • - Capacity: 300 Lbs - Six Swivel Casters - Package Dimension: 21.85 x 17.33 x 4.61 inch - GW: 18 Lbs
Hydraulic Jack		Uline	• Lifts vehicles efficiently for maintenance.	• Actual: ▫ Max Lift: 21 1/16" ▫ Handle Length: 49 1/4" • Height: 9" • Unit Width: ▫ Front: 11 1/8" ▫ Back: 13 1/4" • Saddle (Diameter): 3 7/8" **MATERIAL:** • Handle: Steel with foam bumper • Saddle: Rubber insert • Casters: Cast iron • 2 13/16" Front: H-10473 • 2 1/4" Rear (Swivel): H-10469
Mechanics Gloves		Mechanix Wear	• Protects hands from cuts, abrasions, and chemicals.	**MATERIAL:** • Palm: Leather-like synthetic • Top: Padded spandex • Panels Between Fingers: Lycra • Patented stretch spandex fits like "second skin." • Protection from cuts and scrapes. • Touchscreen compatible.
Tool Chest		Husky	• Offers secure storage for a variety of tools.	• The Husky 41 in. 7-Drawer Mobile Workbench is now available! This unit is constructed with welded steel and has a 7/10 in. solid wood top that provides 742 square inches of workspace. Seven drawers of varying sizes create 12,427 cubic in. of storage capacity. Each drawer has ball-bearing drawer slides that are rated for 100 lb. and have a secure-latch retention system. Pre-cut liners are included to protect both your tools and drawers. The workbench can easily move around your workspace on 5 in. x 2 in. casters, which support up to 1500 lb. • Welded Steel Construction with a black Powder-coated finish • Full extension 100 lb. Rated Ball Bearing Drawer Slides with Secure-Latch Retention System • 12,427 cu. In Tool Storage Capacity • 7/10 inch Thick Solid Wood Top provides 742 sq inch of Workspace • Drawer Liners included • Four casters support up to 1500 lb.

Torque Wrench		Tekton	• Ensures precise tightening of bolts for accurate assembly.	Specifications: • Range - ft.-lb.: 10-150 ft.-lb. • Range - Nm: 13.6-203.5 Nm • Increment: 1 ft.-lb. (1.36 Nm) • Accuracy: ± 4 percent • Length: 18-3/8 inch • Ratchet: 24 tooth • Country of Origin: Taiwan
Impact Wrench		Ingersoll Rand	• Speeds up the process of loosening/ tightening nuts and bolts.	• PRO PERFORMANCE: This Air Impact Wrench tackles heavy duty assembly and disassembly applications, suspension work, and industrial equipment repair with exceptional performance and control; Delivers up to 1,350 foot-pounds of nut busting torque • LIGHTWEIGHT DESIGN: Impact wrench tool is compact and light; Weighing only 4.6 lbs, it offers the best power to weight ratio in its class and minimizes hand fatigue so you can work harder and faster • DURABLE RELIABILITY: Titanium hammer case and steel wear plate protect the tool from the harsh environments and can withstand repeated drops; Every component, mechanism, and function has undergone rigorous testing to ensure long-lasting performance • SUPERIOR CONTROL: Using the four position power regulator, you can seamlessly switch between power modes and adjust torque output for each task; The one-handed forward/reverse mechanism lets you change direction with a simple button push
Diagnostic Scanner		Autel	• Identifies and troubleshoots vehicle issues through OBD-II.	• 28+ maintenance service for 150+ brands, 13+ languages • Newly released powerful bi-directional control • OE-level complete full system diagnostics • Auto Auth for 2017 & later FCA cars • Renault security gateway function • Auto VIN & Auto Scan, inspection endoscope supported • Dealer-like capabilities and factory-level services provide you the ultimate all-round & in-depth diagnoses
Oil Drain Pan		Lumax	• Facilitates easy and clean oil changes.	• The plastic oil drain pan - green, has a 3.75 gallon capacity, a 90 degree pouring spout, splash guards and handles, is made of tough polyethylene which is impervious to oil, gasoline, anti-freeze, etc. It is constructed of durable, oil resistant plastic which will not rust or dent, is easy to clean, and will withstand normal temperature extremes.
Shop Light		Neiko	• Provides bright illumination for detailed work.	• High intensity, SMD-LEDS puts out 300 lumens, features a rugged, anodized, aluminium body and sturdy plastic lens. 3.7V 4000 mAh rechargeable lithium-ion battery. Included charger also features overcharge and discharge protection that maintains longevity of the internal lithium-ion battery. A low battery indicator automatically switches on when the battery is low. The unit is charged with the 120v AC/DC adaptor included in the package.

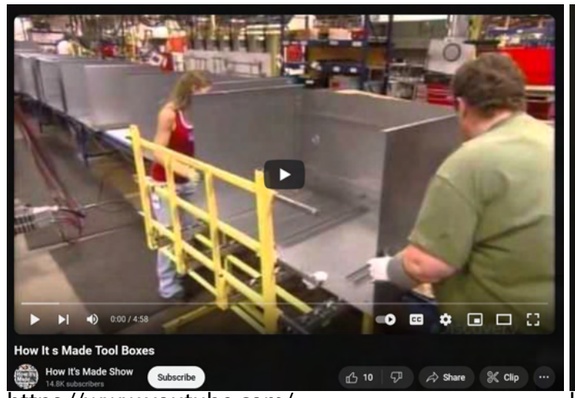
Task: Changing a tire	Ergonomics	Efficiency	Interaction	Satisfaction
Gather Materials	Bending Reaching Walking to gather materials	If not stored properly takes a a lot of time to collect and then put back	Grabbing tools from storage	No - Messy
Lift Car with Jack	Manually pumping jack • Arm Pressure	Less efficient than automatic lift	Grip on jack handle	No - Take more work and time than a automatic lift
Loosen Lug Nuts	Hold wrench with hand while collecting lug nuts	Easy if your hands have full range of motion and has to happen	Grip on wrench	Easy if your hands have full range of motion and has to happen
Replace tire	Lifting tire surrounding cleared for safety	Takes a bit of time to carry heavy tire	• Grip on tire • Bending at the back to place down	Physically tiring
Tighten Lug Nuts	Use hands to manually tighten lug nuts - Grip strength	Easy if your hands have full range of motion and has to happen	Grip on wrench	Easy if your hands have full range of motion and has to happen
Let Car Down	Manually pumping jack • Arm Pressure	Less efficient than automatic lift	Grip on jack handle	No - Take more work and time than a automatic lift
Check Pressure	Checking tire pressure involves put gauge	Easy if your hands have full range of motion	Grip on gauge	N/A

Result Analysis

Problems current mobile auto mechanics face

1. Organization
2. Parts falling out / Drawers falling out when driving
3. Back and forth between car and workstation
4. Uneven ground
5. Lighting to let ppl know you're there - 4 ways
6. not enough room from jack
7. tools on floor

BOM Info/Data



https://www.youtube.com/watch?v=63VDmI4mMew

https://www.youtube.com/watch?v=Ausc0dBW5W0

Mild Steel Gauge Chart*		
Gauge Number	Inches	MM
7	.1793	4.554
8	.1644	4.175
9	.1495	3.797
10	.1345	3.416
11	.1196	3.038
12	.1046	2.656
14	.0747	1.897
16	.0598	1.518
18	.0478	1.214
20	.0359	.911
22	.0299	.759
24	.0239	.607
26	.0179	.454
28	.0149	.378

Sustainability Info/Data

Approval Forms and Plans

IDSN 4002/4502
SENIOR LEVEL THESIS ONE AND TWO

Humber ITAL / Faculty of Media & Creative Arts
Bachelor of Industrial Design / FALL 2023
Catherine Chong

FTA-2 (B) THESIS TOPIC APPROVAL (Preliminary Abstract)

THESIS TOPIC APPROVAL:

Student Name:	Eve Mills
Topic / Problem Definition:	How Might we improve accessibility to auto mechanics?

TOPIC DESCRIPTIVE SUMMARY (PRELIMINARY ABSTRACT)

The accessibility to auto mechanics represents a significant challenge in the automotive industry, as it impacts individuals from diverse backgrounds and abilities. This topic encompasses several dimensions, including physical accessibility for people with disabilities, financial accessibility for those with limited resources, and educational accessibility for individuals with varying levels of automotive knowledge. This design topic aims to understand why existing solutions fall short in meeting the diverse needs of this user group and why it is imperative to bridge the accessibility gap within the automotive repair industry. The research will involve a meticulous evaluation and analysis of current automotive repair practices, accessibility barriers, and user experiences. Through user surveys, field observations, ergonomic studies, and interviews with auto mechanics and customers, it is intended to uncover the specific pain points and areas for improvement. Moving forward, a solution for the challenges faced in the auto mechanic industry will be developed. By improving accessibility in these areas, it can create a more inclusive and equitable automotive repair industry.

Student Signature:	Instructor Signature:
Date: 6/10/2023	Date: 12 October 2023

PANEL ON RESEARCH ETHICS
Navigating the ethics of human research

TCPS 2: CORE 2022

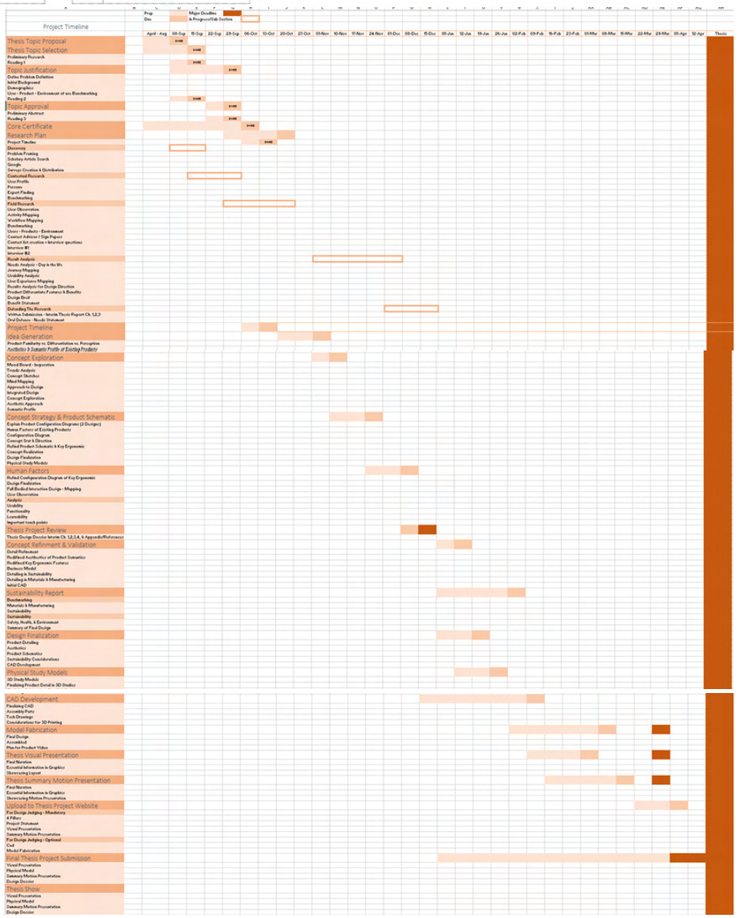
Certificate of Completion

This document certifies that

Eve Mills

successfully completed the Course on Research Ethics based on the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2: CORE 2022)

Certificate # 0000953087 **8 September, 2023**



Project Timeline

- Thesis Topic Proposal
- Thesis Topic Selection
- Topic Justification
- Topic Approval
- Core Certificate
- Research Plan
- Project Timeline
- Idea Generation
- Concept Exploration
- Concept Strategy & Product Schematic
- Thesis Project Review
- Concept Refinment & validation
- Sustainability Report
- Design Finalization
- Physical Study Models
- CAD Development
- Model Fabrication
- Thesis Visual Presentation
- Thesis Summary Motion Presentation
- Upload to Thesis Project Website
- Final Thesis Project Submission
- Thesis Show

Advisor Meetings & Agreement Forms

IDSN 4002/4502 — HUMBER — INFORMATION LETTER

Research Study Topic: How might we increase accessibility to auto mechanics
Investigator: Eve Mills, evemills00@gmail.com, 647-328-9927
Supervisor: Heather Ehaj, Faculty of Media & Creative Arts (IDSN 4002 & IDSN 4502)

Introduction
My name is Eve Mills. I am an industrial design student at Humber ITAL, and I am inviting your participation in a research study on various problems that professional auto mechanics and their customers deal with. Access to reliable and convenient automotive services is crucial in a society heavily reliant on personal vehicles. The results will be contributed to my Senior Level Thesis project.

Purpose of the Study
This study is being conducted as an aid in designing a product/concept that is capable of improving auto mechanics work life as well as those who they serve. With your help, I plan to address problems that auto mechanics and their customers face on a regular basis. This study is primarily based on understanding ergonomics, human interaction design activities, and user experience aspects of the research area.

Procedures
If you consent to volunteer and participate in this study, you may be asked questions pertaining to the topic of auto mechanics and your experiences in the industry as well as your views and needs pertaining to being a mechanic.

Confidentiality
Every effort will be made to ensure confidentiality of any identifying information that is obtained during the study. In the case of being recorded visually, your face will be shielded (blurred or hidden). This information and documentations (photographic) gathered are all subject to being used in the final presentation of the study.

Participation and Withdrawal
Your participation in this study is completely voluntary and you may participate or end the study and the session at any time without giving a reason or fear of being penalized.

P.S. any point during the session, you feel uncomfortable and wish to end your participation, please let me knowand know and they will end your participation immediately.

Humber Research Ethics Board
This research project/ inquiries has been approved by the Humber Research Ethics Board. If you have any questions about your rights as a research participant, please contact Dr. Lydia Bryden, Ethics Chair, 416-675-6622 ext. 79322, Lydia.Bryden@humber.ca

IDSN 4002/4502 — HUMBER — INFORMATION LETTER

Conditions of Participation
- ✔ I understand that I am free to withdraw from the study at any time without any consequences.
- ✔ I understand that my participation in this study is confidential. (i.e. the researcher will know but will not disclose my identity)
- ✔ My identity will be masked.
- ✔ I understand that the data from this study may be published.

☒ I have read the information presented above and I understand this agreement. I voluntarily agree to take part in this study.

Jacob Wilshire — Participant's Name — Participant's Signature — 09/17/24 — Date

Project Information
Thank you very much for your time and help in making this study possible. If you have any queries or wish to know more about this Senior Level Thesis project, please contact me at the followings:
Phone: 647 - 328 - 9927
Email: evemills00@gmail.com

My supervisors are
Prof. Catherine Chong, catherine.chong@humber.ca

IDSN 4002/4502 — HUMBER — PARTICIPANT INFORMED CONSENT FORM

Research Study Topic: How might we increase accessibility to auto mechanics
Investigator: Eve Mills, evemills00@gmail.com, 647-328-9927
Supervisor: Heather Ehaj, Faculty of Media & Creative Arts (IDSN 4002 & IDSN 4502)

I, Jacob Wilshire, have carefully read the information Letter for the project about increasing accessibility to auto mechanics, led by Eve Mills. A member of the research team has explained the project to me and has answered all of my questions about it. I understand that if I have additional questions about the project, I can contact Eve Mills at any time during the project.

I understand that my participation is voluntary and give my consent freely. In case recording, photography and/or videotaping, with the process that my identity will be blurred in reports and publications.

Consent for Publication: Add a ☒ mark in one of the columns for each activity

Activities	YES	NO
Publication	I give consent for publication of the material (Senior Digital Repository which is an open access portal available to the public)	☒	☐
Review	I give consent to the review by the Professor	☒	☐

Privacy
All data gathered is stored anonymously and kept confidential. Only the principal investigator researcher, Eve Mills and Prof. Catherine Chong may access and analyze the data. All published data will be coded, so that should data in the identifiable measurements will be used to quote a participant, pseudonym and data would be aggregated.

I also understand that I may decline to withdraw from participation at any time, without negative consequences.

I understand that I can verify the ethical approval of this study, or raise any concerns I may have by contacting the Humber Research Ethics Board, Dr. Lydia Bryden, 416-675-6622 ext. 79322, Lydia.Bryden@humber.ca or Eve Mills, evemills00@gmail.com, 647-328-9927.

Verification of having read the Informed Consent Form

☒ I have read the Informed Consent Form

My signature below verifies that I have read this document and give consent to the use of the data from questionnaires and interviews in research report, publications (if any), and presentations with the proviso that my identity will not be disclosed. I have received a copy of the Information Letter, and that I agree to participate in the research project as it has been described in the Information Letter.

Jacob Wilshire — Participant's Name — Participant's Signature — 09/17/24 — Date

Advisor Meeting

Date Met & Approximate meeting time
October 8th - 10 min
October 16th - 5 min
October 28th - 15 min
December 30th - 10 min

Notes

- Customers don't trust too much
- Regular maintenance is a must
- Price and location are common barriers
- Faulty engine is the most common cause for a visit

Other Interview Meetings

Date Met & Approximate meeting time
October 14th - 5 min
October 16th - 5 min
October 30th - 10 min
December 14th - 10 min

Notes

- Personal tool box
- Not much access to dealer specific tooling
- Most common jobs: Regular maintenance, oil changes, coolant flushes, complaints of braking, fault codes or lights on dash
- Hard to access mechanics in northern areas

MECHXPRESS

Mobile Auto Mechanic Unit
Eve Mills

Bachelor of Industrial Design