

EquiScribe
Dundas Square Removable Arm Desk Redesign

Shams Mehreen Baig (501210677), Jaundel Simon (501185942), Robert Stroia (501227279), Abieshan Jebaranjan (501237614), Kirusanth Palakanthan (501232510), Lauren Smith (501232080), Mazen Awad (501228117), Sohrab Khabiri (501223731), Otto Yu (501230828), Negara Habiba Neha (501273780)

CEN100 - Introduction to Engineering

Section: 12

Professor: L. Amleh

Teaching Assistant: J. Moore

PM: Neka Umakanth

November 22, 2023

ABSTRACT

This report outlines a comprehensive redesign for the Removable Arm Desk located in Yonge-Dundas Square. This redesign is necessary due to the instability and inaccessibility for left-handed individuals. The only support given to the system is the right cup holder, hence when certain amounts of pressure are applied away from this support, the desk bends at an uncomfortable writing angle. Furthermore, the current model was designed with a truncated left side for easy exit and to accommodate adjacent desks, resulting in an absence of a surface for southpaws to rest their arms. Many iterations were conceptualised and tested to address these limitations and overall optimise user satisfaction. The primary improvement entails the use of both cupholders which laterally centralises the mass and offers left handed individuals the opportunity to rest their arms. For this to be implemented the supports only partially encompass half of each cup holder, allowing for adjacent tables to be placed beside them. Sustainable manufacturing processes and materials are another noteworthy improvement. The last key enhancements are the relocation of the surface closer to the user to centre the mass longitudinally and create additional walk space. These modifications are significant and can impact student success, as they directly affect students during exams and lengthy lectures. The inadequacies of the current tables lead most students to abandon their use during lectures and, in a primitive fashion, resort to writing on their lap due to it being a disruption to their learning. In the pursuit of ongoing improvement and with a deep-seated allegiance to the foundational design principles of engineering, this redesign is dedicated to enhancing the learning experience of all Toronto Metropolitan students attending classes in Yonge-Dundas Square.

INTRODUCTION

The arm desks given to Toronto Metropolitan University students by the Dundas Square Cineplex Cinemas contain several design flaws that degrade the student's experience and the image of the university as a whole, the most notable being the lack of support for left handed students. The arm desk is designed to only clip into the right cup holder and does not have adequate support to hold up the desk across the entire width, creating a sag that affects student's writing and typing ability. This directly goes against the university's goal of inclusivity by offering a product which not all students are able to use effectively. Moreover, using a laptop on the arm desk is often not practical again due to the sag. As more students are moving into the twenty-first century and typing notes, it is crucial that they have a properly stable desk to put their laptops on. When in class, it is important for students to have their undivided attention to their lectures. Instead, they lose their focus due to the instability of the desk as they always need to keep adjusting it while taking notes. Due to the sag, most of the students end up putting their laptops on their laps instead of using the arm desk which is even more bothersome. During exam periods all students are already stressed enough but the situation gets even harder for them because it is absolutely impossible for students to write their exam papers on the desk they are given in peace.

The hard plastic trays also have a considerable environmental impact over their lifecycle. Starting from production, they do not leverage any sustainable design practices and instead resort to harmful single use plastics. The manufacturing process involves the extraction of fossil fuels to create plastic resin and a chemical process to cure that resin into solid plastic [8]. Combined with shipping and transportation emissions leads this product to have a large carbon footprint before it is even being used. After the product has been depreciated, even recycling it is off the table. Only an estimated 9% of plastics worldwide are properly recycled, with the rest spending 100s of years decomposing in landfills [7]. In the redesign, this issue is addressed by implementing sustainable materials.

BACKGROUND

A redesign is planned for the Dundas Square Cineplex's Removable Arm Desk to improve students' experience and address important restrictions. Its main problems are its inability to accommodate left-handed users and its cup holder's exclusive placement on the right side. Left-handed users' concerns may have needed to be addressed in historical development, as the original design aimed to offer students a comfortable surface. The main engineering objectives are to make the product accessible to left- and right-handed users and to increase stability by putting in place a strong support system. The suggested redesign prioritises stability, diversity, and an enhanced user experience for students altogether. Currently, the product is completely manufactured through a process called “injection moulding”. Heated liquid is poured into a positive mould which houses the shape of the finished product. This liquid is then cooled to set the piece and ejected as a full product [10]. Only polyvinyl chloride, commonly known as PVC, is used for the injection. The tray comes in two parts, the tray itself (Blue) and the cupholder (Grey), which can be attached flush into the hole of the tray. Images of the rudimentary form of the original product and individual parts as well as an interactive model have been included below. This form does not include adjustments to reduce costs such as removing material from the underside, but rather illustrates the general idea of the shape and use of the product.

Table 1: Bill of Materials

Part Name	Total Quantity Required	Unit Cost
PVC	800g	\$10

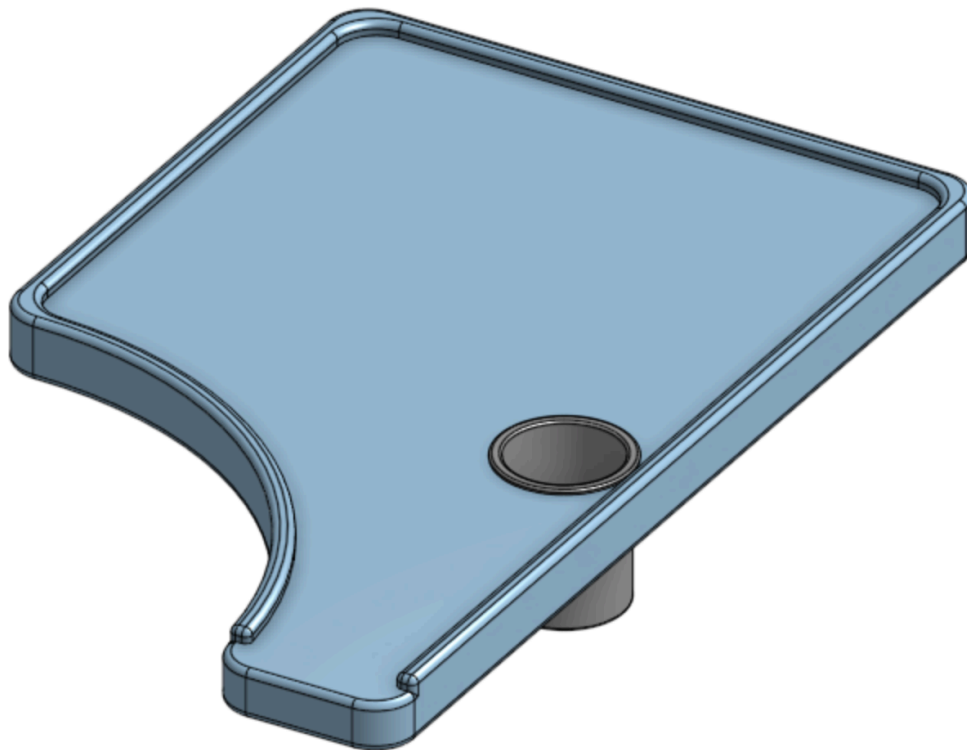


Figure 1: Rendering of the original desk design. Source:

<https://cad.onshape.com/documents/6faa23fcc9e653bc06bca463/w/ae6d6f9e821c1f5e13590628/e/abe6d661774aebc896763577?renderMode=0&uiState=655401786bc1447a3797c36b>

EVALUATION

Sustainability:

The original design for the desk was made out of single-use plastic, as it is durable and cheap, catering to the fact that the desks would be regularly used by university students and would have to be replaced often [1]. However, the prevalent use of single-use plastics in items such as these desks, which may be replaced every few years, has become a large contributor to the growing pollution of oceans and landfills. It is estimated that between 1950 and 2015, a total of 6.3 billion tonnes of primary and secondary (recycled) plastic waste was generated, of which around 9% has been recycled, and 12% incinerated, with the remaining 79% either being stored in landfills or having been released directly into the natural environment [2]. In addition, a study done by the government of Canada in 2018 showed that Canada exported over 100,000 tonnes of plastic waste to other countries, where it ended up in foreign landfills and oceans [3].

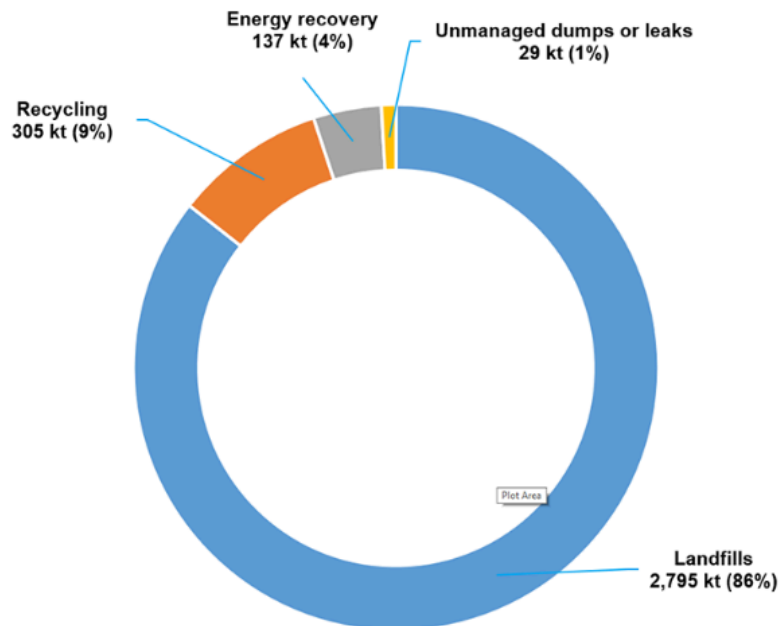


Figure 2: A breakdown of the destinations of plastic waste in Canada. Source: [3]

To address these environmental concerns, our improved design would consist of a compostable bioplastic made of cornstarch, sugar, and used cooking oil, blended with PLA (polylactic acid) and PHB (polyhydroxybutyrate) [4]. The use of this material would be an effective alternative to the single-use plastics as it would increase the lifespan of the desk and easily disintegrate after the desk has been thrown away. The bioplastic material has a lifespan of up to 15 years, and when discarded into compost will completely disintegrate within 90 days [4].



Figure 3: The bioplastic used to manufacture the table. Source: Lauren Smith

In comparison to the life cycle of other commonly used plastics, which can take anywhere from 20 to 500 years to decompose, this new material as shown in figure 2, will mitigate the environmental impact of producing the desk.

Profitability:

Our product is set to produce a substantial amount of revenue for the company producing it. On average, bioplastics can cost anywhere from \$2-\$7 per kilogram, so the cost estimation for the production of each desk should cost about \$5, although the price if the desk was made in real life could be anywhere from 10-30% cheaper when factoring in bulk discounts given by companies to manufacturers.

Taking into consideration the versatile application of the redesigned desks, especially in Cineplex theatres across Canada, there is a large potential for revenue. Universities such as Toronto Metropolitan University, University of Toronto, and York University host classes in Cineplex theatres, and the desks also serve as part of the Cineplex VIP events as they are used as a surface for movie-goers to enjoy food while watching movies.

Given that there are about 200 Cineplex theatres in Canada [5], if each desk were to be sold for \$30, and each Cineplex in Canada bought 500 desks, the projected profit solely from Canadian Cineplexes would be \$3 million. This estimate does not include potential sales to Cineplex and other theatres in other North American countries which would further increase profit.

After deducting the cost of production from the profit, the company would be bringing in a revenue of \$2500,000 from Cineplexes in Canada alone. In addition, the company could also expand into additional markets to bring in further profit. For instance, if they shift their consumer focus to also target elderly people, or hospitals, they could stand to make even more money. Hospitals already use cup holder tables for those in hospital beds, and elderly people often use tray tables to hold their things as they sit and

do activities. By expanding the customer focus to include various demographics, the company could tap into various markets, ensuring financial success.

Durability :

The durability of the redesigned desk is fundamental to its long-term viability and sustainability. Switching from single-use plastic to compostable bioplastics represents a significant improvement in office sustainability and longevity. Bioplastic material made from cornstarch, sugar, and used cooking oil mixed with PLA and PHB provides outstanding durability, capable of withstanding frequent and prolonged use. This durable component ensures that the desk can withstand the rigours of daily use in busy university environments and long-term Cineplex theatres [4]. With a lifespan of up to 15 years, the desk promises to be a long-term investment, minimising the need for frequent replacement which in the long run will save money [4].

User Experience (UX):

Improved user experience is the focus of the redesigned desk, including usability, accessibility, and overall satisfaction with its use. The overarching goal of the redesign was to create a desk that meets the diverse needs of students and film lovers, ensuring that it not only meets basic functionality but also provides a comfortable and enjoyable experience. Improved stability and support for left-handed users directly addresses limitations that previously hindered the desk's usability. By centralising the volume of the desk with two cup holders and ensuring surface space for left-handed users, the redesigned desk ensures a more inclusive and user-friendly experience for all. In addition to making the desk more inclusive, we wanted to focus a lot on the stability of the desk to help students have a more stable writing desk for notetaking and writing midterm exams. The use of two cup holders provides a better base for the desk to latch onto which in return fixes the issue that many students face with the instability of the table. In summary, user experience in the proposed redesign of the Yonge-Dundas Square Arm Desk highlights its commitment to creating an inclusive, stable and user-friendly product. By addressing user experience in a thoughtful and considerate manner, the redesign is expected to significantly improve the learning and viewing experience for students and customers to provide an improved experience with the desks.

Affordability and Accessibility:

Accessibility refers to how individuals or groups can acquire and use an object, product, or service. Several factors contribute to accessibility, including location and infrastructure. Although our team has developed the object in a manner it falls short in terms of being accessible to people worldwide. As a result, we intend to reach out to Caddy Products with our concerns and propose a solution we have devised. We hope that they can help us by incorporating our product into their existing line of Caddy Products. Given their presence in over 91 countries with over 270,000 users our product will become readily accessible for university students attending lectures at Cineplex theatres around the world[6]. Import and export considerations are also factors that make Caddy Product an ideal choice since they are based in the United States with cost-effective transportation options ensuring accessibility across various locations.

Affordability refers to the ability of individuals or groups to purchase an item or product without facing any strain. Factors such as income levels and the availability of resources play a role in determining affordability. As mentioned earlier regarding profitability it is expected that the item should ideally be priced at around \$5.00. Even if it were to be sold for \$30 and assuming each Cineplex purchased 500

desks the projected profit for Cineplex should amount to \$3 million [5]. Therefore, affordability should not be an issue. Although the cost of living is increasing rapidly these days impacting affordability, market competition plays a role in driving prices down. This ultimately benefits organisations, like Caddy Products competing against Amazon and Walmart that aim to make their products more affordable. Considering that university students often spend hundreds of dollars on textbooks, spending a few dollars on an item shouldn't be a concern and can be advantageous.

Public good:

The Dundas Square Removable Arm Desk product addresses a meaningful public need, specifically for Toronto Metropolitan undergraduates studying at the Young-Dundas lectures. One improvement is that it only partially covers half of each cup holder making it possible to place tables next to them which makes implementing the enhancement easier. This way the students don't have to struggle with poor back postures such as bent arms, knees, and even rounded shoulders. This new redesign helps by increasing spaces for students to leave their arms to rest while still being able to comfortably take lecture notes. Another notable improvement is the addition of a mechanism that brings the table closer to the user. However, it not only ensures that the table is positioned centrally but creates more space for walking. To address this we considered incorporating supports that pass through the cupholder holes or adding triangular stoppers beneath the desk to counteract any forces exerted beyond the armrest.

These changes have an impact on student success since they directly affect students during exams and long lectures. For example, students start to lose interest in attending lectures as they find it pointless to take notes on the current removable arm desk. Our product not only accommodates the needs of university students but also offers advantages to another group of people; those who visit Cineplex to watch movies. It can serve as an armrest enhancing viewers' comfort during their movie-watching experience. Additionally, it provides a spot for placing snacks like popcorn and candy preventing any spills, on the floor or personal belongings.

Performance:

In the recent desk redesign at Yonge and Dundas Square, stability was a major challenge, especially when students put pressure on their hands and write. A thoughtful solution has been introduced to address this issue. On either side of the theatre chair, we installed two cup holder fitters to accommodate the desk. This ingenious addition not only provides structural support and stability to the desk but also effectively solves the problem of falling due to external forces. The strategic integration of these improvements is intended to create a more stable and user-friendly desk for the benefit of students and users at Toronto Metropolitan University. This thoughtful improvement improves the desk's functionality and reliability, providing a more comfortable and secure experience for users. The product's strong performance can be attributed to the high-quality materials used in its construction. Overall, the product performs well to its intended function through a high degree of comfort and compressible build which makes students learn with ease.

REDESIGN PROPOSAL

Under the aforementioned criteria set to be improved upon, new designs proposed were set to improve on sustainability, UX, and profitability. These factors were ultimately altered; more sustainable materials were used, even staying around the same melting point so part of the manufacturing process was

minimally changed. Accessibility was enhanced, allowing both left and right-handed users to use the desk effectively. Profitability is clear, as mentioned, larger demographics can implement an use for the trays, as well as cheaper materials being used. Improvements and changes proposed included stability enhancements, dimension and form alterations, accessibility for left-handed users, and sustainable manufacturing.

Stability Enhancement:

Introducing a dual cup holder design in order to centralise the centre of mass laterally will allow users to write or type notes and exams much easier. If left unaltered, crucial time and effort may be wasted on ensuring that the tray does not tip or jolt when used. By incorporating dual-cup holders to distribute the weight evenly on both sides, the desk achieves lateral balance. This not only prevents tipping but also ensures a more stable and reliable workspace for users. The dual cup holders also serve the dual purpose of providing additional space for users to work comfortably.

Dimension and Form Alteration:

Introduction of altered lengths will allow users to have a more ergonomic learning experience. Significantly reducing the base of the table from the front and bringing the tray “closer” to the user allows the user to write without bending over and straining their back. The reduction in the table base is a key design modification that creates a more spacious side-to-side layout. Furthermore, this alteration not only addresses spatial concerns for users but also significantly enhances stability. A reduced base minimises the risk of tipping, even when pressure is applied away from the cupholder support. Users can now confidently engage with the desk, knowing it remains steady and secure during use. Next, a semi-circular cutout rather than a full cup holder is a strategic design choice aimed at improving user comfort and ergonomics. This feature brings the table closer to the user, reducing strain during writing or working activities. The cutout also ensures that the hand rest reaches almost all the way to the end of the table, further enhancing stability. Users will appreciate the enhanced usability and comfort offered by this thoughtful design modification. This also allows the trays to be placed side by side as it takes up half of each cup holder hole in the seats.

Accessibility - Left-Handed User Support:

The proposed design alterations also supported by the introduction of dual cupholders and dimension alteration also facilitates left-handed users. Stability addresses the needs of left-handed users; the introduction of dual cup holders allows left-handed individuals to comfortably rest their arm and write on the left side of the desk. This thoughtful adaptation enhances inclusivity, making the desk more user-friendly for a broader audience, addressing a significant limitation of the original model.

Sustainable Manufacturing:

Exploring environmentally friendly materials and optimising the manufacturing process for sustainability will allow a safer long-term growth. Commitments to sustainable manufacturing is a noteworthy improvement in the redesign. By exploring environmentally friendly materials and optimising the manufacturing process, the desk aligns with broader environmental goals. This not only reflects a socially responsible approach but also acknowledges the importance of reducing the product's overall environmental impact. The simplification of the design itself may contribute to a more streamlined manufacturing process, potentially furthering sustainability objectives.

Iteration Process

Design Criteria and Constraints:

The new design aims to meet several criteria, including centralising the centre of mass, consolidating the desk to support 10 kilograms, providing enough platform space to accommodate large laptops, and left handed users, increasing walk space, and retaining stackability and usable cupholders. The main constraint in achieving this objective lies in the manufacturing cost as the tables must be affordable enough for theatres to transition to the new design.

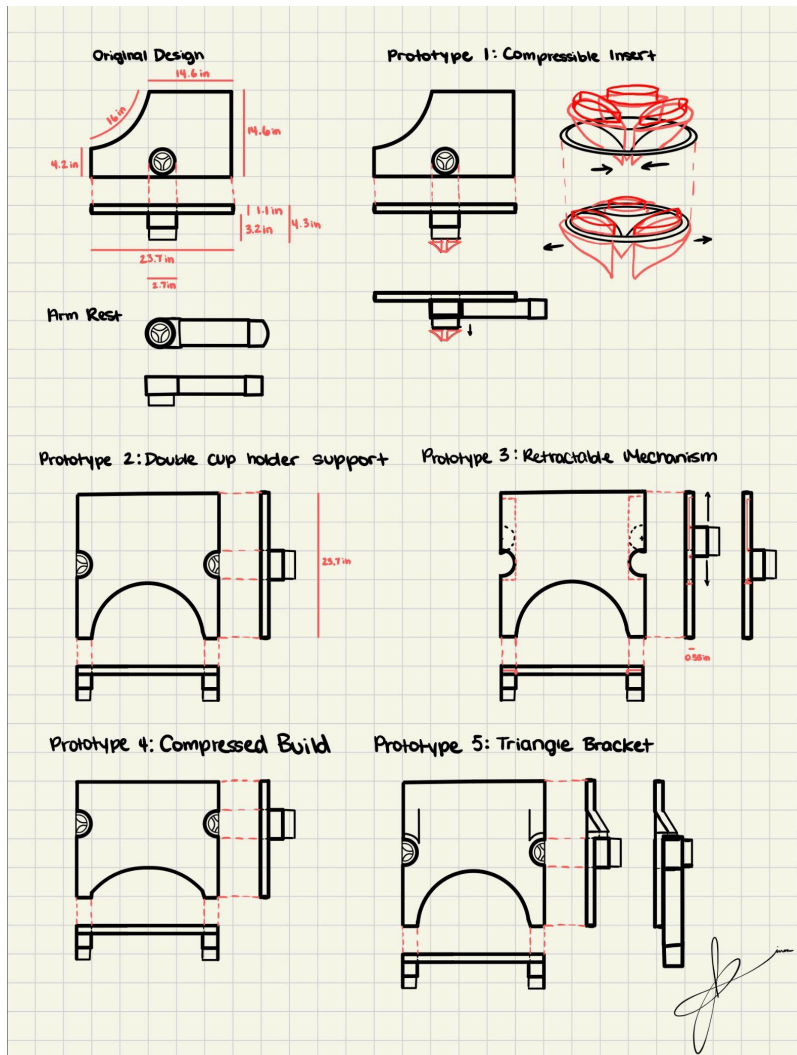


Figure 4: Iterations of the Equiscribe. Source: Jaundel Simon

Prototype Analysis:

In Figure 4, the first prototype envisioned consists of rounded triangular hooks affixed to the underside of the supporting cup holder. These hooks are designed to be compressible, allowing them to be inserted through the cup holder's holes and then expand outward. The downward force exerted onto the surface generates an upward force on the cup holder, and the hooks counteract this force with a downward normal force preventing displacement. When the table needs to be removed from the armrest, the hooks can be compressed while lifting the table. This iteration faced rejection due to its inherent impracticality for left-handed users and the inability to stack the tables. The second prototype addresses these concerns by extending the table to the left, utilising both cup holders. This adjustment not only provides a surface for left-handed users but also centralises the desk's gravity, allowing it to support significantly more weight. To accommodate adjacent desks, only half of the cupholder is

encompassed by the supports. This modification served as the foundation for future prototypes, however, it comes with certain drawbacks. Issues include potential insecurities with heavy weights positioned longitudinally away from the supports and the abolishment of exiting and entering while the table is in place. A retractable mechanism was implemented in the third prototype to address weight insecurities, allow adjustability, and increase walk space. Utilising wheels running through a T-Track within the width of the desk both cup holder supports can synchronously move when the table is placed in order for the

platform to be closer to the user and to limit the amount of surface that is away from the arm rest that is providing normal forces. The cup holders can then be easily returned to its original position for the desk to stack with others. However this mechanism is expensive, and has a high chance of breaking when subject to prolonged and frequent use. It was then discerned that the same advantages can be achieved by shifting the platform entirely to be closer to the user which can be discerned in the fourth prototype. To make up for surface area loss the curvature of the cut out was reduced which may limit accessibility for individuals with a fuller frame. Subsequently in prototype five, the curvature was kept and a triangle bracket was integrated at the bottom of the desk. The gap between the supporting cupholder and the triangle bracket is filled by the armrest cupholder, and much like a triangle bracket shelf, supports weight beyond the cupholder. To maintain stackability the platform embodies the triangle bracket which causes crevasse on the design that may hinder the desk's performance. The team opted to revert back to the fourth prototype as a uniform surface held higher precedence than accessibility for individuals with fuller bodies. This decision was made because the distance between the backrest of the chair and the desk would still exceed that of the auditorium desks at Ted Rogers School of Management, which is 13 inches.

Evaluation Criteria

The new version will be an improvement based on the following criteria:

User Satisfaction:

The reduction in the table base, semi-circular cutout, and improved cupholder accessibility address key user concerns and contribute to increased user satisfaction by addressing comfort and usability concerns. Ergonomic design allows users' improved comfort and usability of the desk.

Stability:

The centralization of the centre of mass laterally and additional support features such as the dual cup holders combined with the reduction in the table base enhance stability, eliminating the issues of bending or instability under pressure. Thus, users can trust that the desk remains stable, even under varying pressures whilst writing notes or typing, contributing to a reliable and secure workspace.

Flexibility and Adaptability:

The modified design maintains a side-to-side spacious layout, providing flexibility in how users can arrange and use the desks in various settings. This adaptability caters to different settings, enhancing the versatility of the product. Lateral space rather than vertical space is used more effectively during writing as users will not be able to write whilst fully extending their arms without sacrificing ergonomic experience. However, users are able to easily rotate left and right between pages or tasks with the use of extended lateral space.

Sustainability:

The exploration of sustainable materials and manufacturing processes aligns with environmental considerations, making the product more socially responsible. The overall redesign seeks to minimise the product's environmental impact, contributing to broader environmental goals and demonstrating the designer's commitment to sustainability. By using eco-safe materials with similar prices to prior material used, the manufacturing process can reduce fines paid for environmental penalties withheld by the Government of Canada [9].

Convenience and Ergonomics:

The semi-circular cutout improves ergonomics by bringing the table closer to the user. This thoughtful design modification ensures a more comfortable writing and working experience, enhancing overall convenience and usability. Users will find the desk more accommodating and user-friendly.

Drawbacks of the Redesigned Table:

While the proposed redesign introduces several positive changes, it is crucial to acknowledge certain drawbacks that may impact user experience and production costs. The reduction in the table base, while contributing to lateral stability, could pose challenges for accessibility during entry and exit. The streamlined design may create a bottleneck, making it less convenient for users, especially those with mobility issues. Additionally, the semi-circular cutout, although enhancing ergonomics, may inadvertently limit accessibility, particularly for individuals with larger body sizes. The desk's design, aiming to provide stability and comfort, might inadvertently exclude users with specific physical needs. Moreover, the incorporation of additional materials to achieve the desired stability and functionality may result in an increase in manufacturing costs. The proportional increase in materials may contribute to a more expensive end product, potentially limiting the affordability and accessibility of the redesigned Removable Arm Desk. It is imperative to strike a balance between innovative design improvements and maintaining inclusivity and cost-effectiveness.

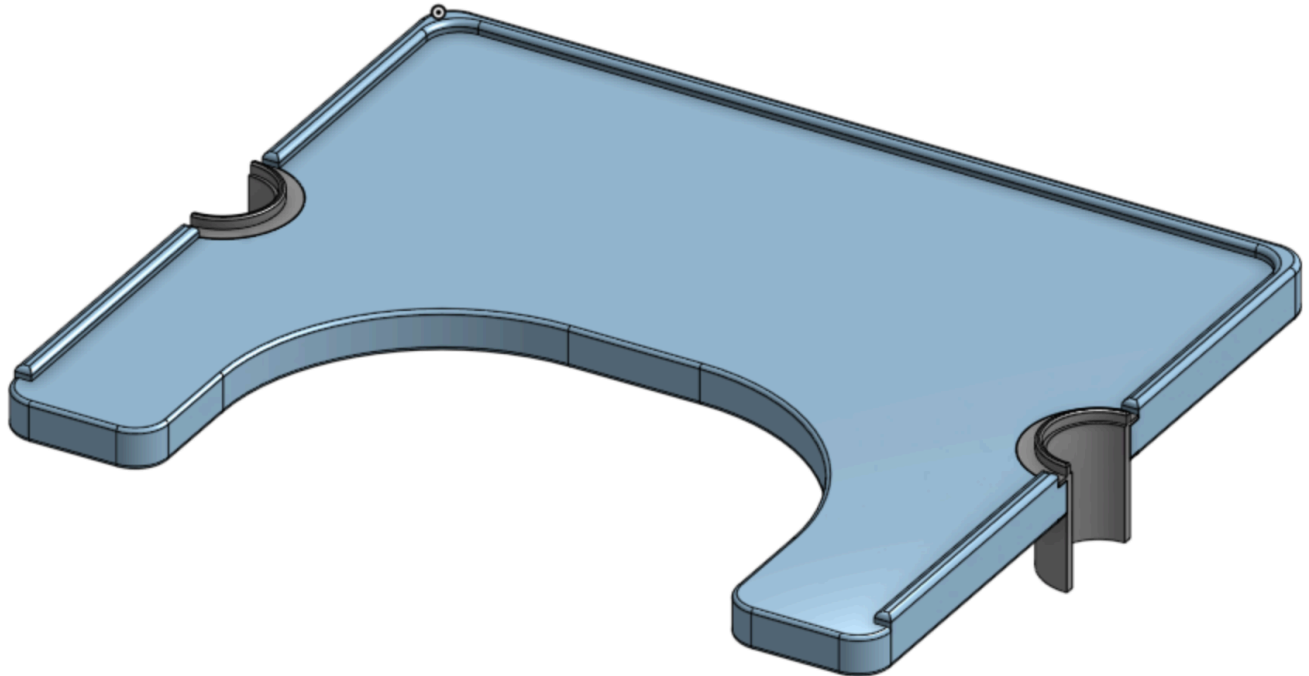


Figure 5: Rendering of the Equiscribe. Source:

<https://cad.onshape.com/documents/00d983fcb873da67ed8e4c5/w/7a4c99fe596a6c8f6cf0339c/e/09be79fd4d6c0cb3131edb06?renderMode=0&uiState=655c3652065f02375fda9ed8>

MARKETING

The marketing aspect of this proposal is not what is expected from a typical product. While current marketing strategies include the competitive aspect in adding new products within the existing market, our goal is to introduce the same product but with enhanced features, such as improved stability and accessibility. Promoting the redesign of the removable arm desk to a corporation could potentially adopt our redesign in place of their current model of the desk, with goals to increase the brand image and user satisfaction. Marketing strategies for promoting the redesign of the current desk model including pointing out the advantages of their existing product, while highlighting some of your concerns and dissatisfactions from our experience in using the product in a practical sense. It's one thing to design a product and sell it, but it's another to have that user satisfaction, that ensures a customer return and/or positive brand image, involving the promotion of their product. In order to effectively promote our enhanced product to the company, it is important that we understand who the company's target market is themselves, so that we can tailor our product in a way that would be pleasing to them, and fit their company goals in reaching their dedicated target markets, including entertainment, grocery, worship, and retail industries, and our goal is to also add to the target market, in building a product that is beneficial to educational institutions as well, increasing brand image and engagement [6]. Furthermore, we've chosen a poster as our primary form of advertisement, while highlighting the enhanced features of the new product as a way to attract our consumers. Our enhanced features can help benefit the target audience, with a focus on educational institutions, as the enhanced features address the limitations and flaws, such as the lack of accessibilities and instabilities, that arise when the desk is used by post secondary students.



Figure 6: Equiscribe marketing poster

REFERENCES

- [1] J. Hopewell, R. Dvorak, and E. Kosior, “Plastics Recycling: Challenges and Opportunities,” *Plastics Recycling: Challenges and Opportunities*, https://www-jstor-org.ezproxy.lib.torontomu.ca/stable/40485985?searchText=single+use+plastic&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Dsingle%2Buse%2Bplastic&ab_segments=0%2Fbasic_search_gsv2%2Fcontrol&refreqid=fastly-default%3Ae1b19398ec454193c1592eac0badb3d5 (accessed Nov. 19, 2023).
- [2] C. J. Rhodes, *Plastic Pollution and Potential Solutions*, https://www-jstor-org.ezproxy.lib.torontomu.ca/stable/26508614?searchText=statistics+about+single+use+plastic+pollution&searchUri=%2Faction%2FdoBasicSearch%3FQuery%3Dstatistics%2Babout%2Bsingle%2Buse%2Bplastic%2Bpollution&ab_segments=0%2Fbasic_search_gsv2%2Fcontrol&refreqid=fastly-default%3A6ac09d556fa5f1b658434470f91b5b94&seq=12 (accessed Nov. 19, 2023).
- [3] S. Yakobowski, “Research publications,” *Global Marine Plastic Pollution: Sources, Solutions and Canada’s Role*, https://lop.parl.ca/sites/PublicWebsite/default/en_CA/ResearchPublications/201937E (accessed Nov. 19, 2023).
- [4] M. Connexions, “Toronto Metropolitan University Home,” *Material Connexions Library*, <https://www-materialconnexion-com.ezproxy.lib.torontomu.ca/998301?activeChild=11169> (accessed Nov. 19, 2023).
- [5] Cineplex, *Cineplex Corporate*, <https://corp.cineplex.com/about> (accessed Nov. 19, 2023).
- [6] C. Products, “Caddy Products,” *Caddy products*, <http://caddyproducts.com/> (accessed Nov. 21, 2023).
- [7] H. Ritchie, V. Samborska, and M. Roser, “Plastic pollution,” *Our World in Data*, <https://ourworldindata.org/plastic-pollution?insight=around-05-of-plastic-waste-ends-up-in-the-ocean#key-insights> (accessed Nov. 21, 2023).
- [8] “The journey of plastic resin: A deep dive into the manufacturing process,” *Thong Guan Industries*, <https://www.thongguan.com/plastic-resin-made-exploring-process/#:~:text=Plastic%20resin%20is%20made%20by,use%20in%20our%20everyday%20lives.> (accessed Nov. 21, 2023).
- [9] Government of Canada, “Environmental penalties,” *ontario.ca*, <https://www.ontario.ca/page/environmental-penalties> (accessed Nov. 21, 2023).
- [10] Hubs, “Injection molding: The Manufacturing & Design Guide,” *Hubs - A PROTOLABS COMPANY*, <https://www.hubs.com/guides/injection-molding/> (accessed Nov. 21, 2023).

