

# Engineering Strategies & Practice

**University of Toronto**  
**Faculty of Applied Science & Engineering**  
**APS112: Conceptual Design Specification (CDS)**

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## Executive Summary

Alyssa Ahmed, the coordinator of Student Life at the University of Toronto's Sussex Clubhouse has expressed several concerns to our team about the building's current arrangement. People are not able to move around the building efficiently, there is a decrease in students that visit the clubhouse as a result of the pandemic, and the design does not have an efficient storage system. The goal of this project is to find a solution that fits these issues. To assess the validity of the solutions, a list of quantified objective goals and constraint limits can help compare each solution to determine the design that best satisfies the client's needs.

The primary function of the Sussex Clubhouse is to provide a free meeting and workspace for clubs and the staff of the University of Toronto. The secondary functions emphasize the need for a collaborative space as well as moving within rooms comfortably. Set goals have been implemented in each solution to maximize solution impact. These objectives include maximizing the utilization of space and having a universal usage of durable and robust furniture and storage that minimizes cost while staying secure and flexible. The constraints of the project were formed to create firm limits of each solution. These boundaries include following building room capacity codes for the City of Toronto as well as keeping all renovations within the first 2 weeks in June. The Space Audit project is scoped to the 4th, 5th and 6th floors solely for club room renovations. The primary stakeholders of this project are the Institutional Equity Office at U of T, the Government of Ontario's Ministry of Municipal Affairs and Housing, and the surrounding Toronto Community who possess great impacts from this project.

In our ideation process, the team used methods such as brainstorming, a SCAMPER Table and the benchmarking of existing UofT buildings to generate a total of 63 storage and space based solutions. Ideas were then removed through a feasibility check, multi-voting, a graphical decision chart, a weighted decision matrix, and a pugh chart to rank our final three alternate designs. Our first solution, "Aris", utilizes drawers, drawer dividers, and sleeve storage to implement better drawer storage in the meeting spaces. Our second solution, "Pandora", aims to divide the meeting rooms into storage and meeting space while using closet and hanging door organizers, stacked storage organizers, and shrinkable furniture to maximize space in the room. Our third solution, "Proteus", creates a designed pathway around each room to better navigate while also implementing multi-purpose furniture such as ottoman seating and foldable tables and chairs.

The next steps for the team are to follow up with the client on the proposed solution, receive feedback on how well the needs are met, and adapt the proposed solution to further changes. A modeled layout will be presented to the client and club leaders. From there the success of an iteration will be measured by completing more user tests on-site.

## 1.0 Introduction

21 Sussex Ave, located in Toronto ON, is an establishment that houses 50 student groups on the 4th, 5th, and 6th floors. This building also serves as an office space for the St.George Campus Safety Special Constable Service [1] and the University of Toronto's Student Newspaper, the Varsity [2]. Alyssa Ahmed, the student life coordinator, requests to reassess and remodel the building's 4th, 5th, and 6th floors [3] to better suit the student's needs.



Figure 1: *Exterior of the Sussex*

## 2.0 Problem Statement

The problem to be addressed around the Sussex Clubhouse is the deficiency in the layout of the space which poses a significant hindrance to students coming to the Clubhouse.(here is the current layout of the clubhouse) The current layout of the Clubhouse consists of small meeting rooms without proper storage as shown in Figure 2. It makes it difficult to move around the rooms and thus discourages more students from visiting the Clubhouse.

The client needs a lively community environment to foster student collaboration and creativity with an efficient storage solution catering to the users' needs. The Clubhouse needs a reassessment of the current space and storage solution.

The redesign covers the 4th to 6th floors of the Clubhouse building and has been scoped to general meeting rooms, club rooms, and storage areas. The engineering team is required to come up with effective solutions to give students more space for club-related storage while maximizing the club room space for meetings and social events.

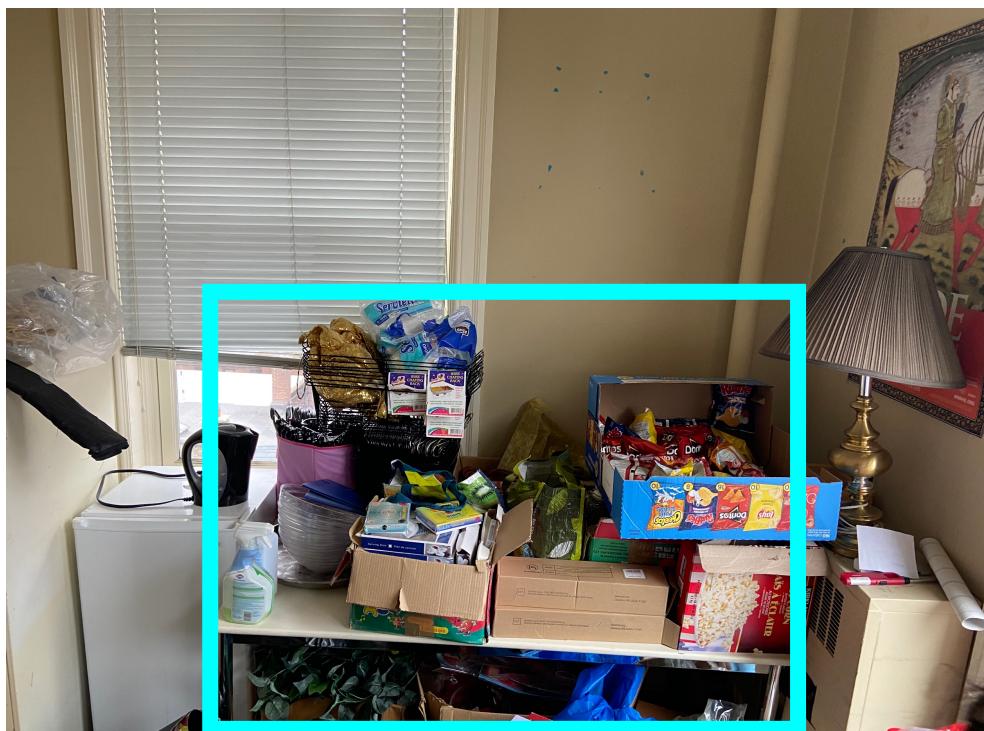


Figure 2: Existing storage situation (using the desk as storage)

### 3.0 Service Environment

This section provides an overview of the environment within the Sussex Clubhouse, offering insights into the environmental conditions of the room sizes, area distribution, aging facilities, and storage capabilities.

#### 3.1.0 Physical Environment

The following table describes the diagram and metrics of the building measurements.

Table 1. *The physical environment with diagrams and metrics*

Diagrams	Metrics
See Appendix F for floor plans of the 4th, 5th, and 6th floors of the Clubhouse.	<p><b>Room Sizes:</b> The dimensions of the rooms range from approximately 5 to 10 square meters.</p>
	<p><b>Storage Capabilities:</b> Several rooms are significantly cluttered, leaving minimal room for people to maneuver around.</p>

Figure 3. *Disorganized storage in Room 529*



Figure 4. *Dance Studio*

#### **Building Age:**

In 1966, the University of Toronto expropriated the property at 21 Sussex Avenue. By the early 21st century, the University of Toronto subsequently renovated it into office spaces for academic and student-led organizations.[4]

#### **Area Distribution:**

- The 4th floor has 4 common areas and 12 club rooms, with two clubs sharing one club room.
- The 5th floor has 2 common areas and 10 club rooms, with two clubs sharing one club room.
- The 6th floor has 7 club rooms, with each club having its dedicated room.
- 1-2 rooms are allocated for large storage lockers from the 4th-5th floor.

(See Appendix D)

#### **3.2.0 Living Things**

Based on the engineering team's site observation, the number of people club rooms can hold is up to a maximum of 20 [5] and a minimum of 6. Club members will occupy the space mostly from 4 to 7 pm and staff will occupy the space for their office [3].

#### **3.3.0 Virtual Environment**

Every student and staff in the building can access the University of Toronto WiFi system [6].

#### **4.0 Stakeholders**

This section determines the stakeholders relevant to the Clubhouse redesign, including the Institutional Equity Office U of T, the Government of Ontario's Ministry of Municipal Affairs and Housing, and the community. The following table shows the impact of the project on the stakeholders.

Table 2. *Stakeholders of the Sussex Clubhouse project*

Stakeholder	Interest Category	Impact on Stakeholders
Institutional Equity Office at U of T	Social	- support clubs focusing on anti-racism, cultural, sexual, and gender diversity guided by the Institutional Equity Office (IEO).[7]
Government of Ontario's Ministry of Municipal Affairs and Housing	Legal	- There is a concern if this project follows relative regulations provided in the Toronto Municipal Codes Chapter 629 [8].
Community	Social	- Can be disturbance to building occupants [9]. - Leisure noise above an average noise of 70 dBA (24-hour average) is not recommended by The World Health Organization [9]

## 5.0 Detailed Requirements

This section highlights the requirements that each solution must follow to satisfy the client's needs, a set of goals that each solution hopes to accomplish in the selection process and defined boundaries that each solution must not cross.

### 5.1 Functions

This section analyzes the purpose of the clubhouse by classifying primary functions and secondary functions. The Black Box Method is used to identify functions that the design must complete to be a viable solution. (Appendix N).

Table 3. *Functions of the Sussex Clubhouse Project*

	Function	Description
Primary Functions	Provide free meeting and work spaces for clubs and the staff of the University of Toronto	The clubhouse was designed to create a sense of community for club events.
Secondary Functions	Transport people around the clubhouse rooms	The design must improve the mobility for users to walk around the room.

	Create a more lively space in the clubhouse building	The design must re-establish the community before the pandemic due to the large decrease in the number of visitors.
	Provide a better storage system for clubs.	The design must provide a better storage option for more organized space and activities

### 5.2 Objectives

This section describes the project's storage and space objectives that will assess the design solutions. The objectives listed below have been put in a Pairwise Comparison Chart [Appendix E] to rank their importance. The project contains many intricacies related to each club and its requirements allowing for a wide range of objectives, metrics, and goals.

Table 4. *Space Objectives of the Sussex Clubhouse Project*

Space Objectives	Goals and Description	Metrics
Maximize utilization of space	<p>The design should allow for clubs to get the most out of their space according to their needs [3].</p> <p>This will help facilitate organized meetings and collaboration.</p>	<p>The design should allow for 1-6, 7-13, or 14-20 students to share space comfortably with one another [5] as Ontario room codes vary depending on size.</p>
Universal usage of furniture	<p>The furniture should be easy to maneuver [10] and create a unified workspace [11] rather than act as a hurdle within the space.</p> <p>Furniture should add to the flexibility of the room. Clubs can move things according to their needs. [3]</p>	<p>The furniture should be able to withstand a minimum of one year of usage (the duration of most clubs) [3].</p>
Durable and Robust	<p>Each club should be able to clean and keep up with the design in their room.</p> <p>[11]</p>	<p>The design should have a maintenance frequency of 1 year [3] and clubs should be able to maintain whatever they take</p>

	<p>Space designs need to be durable and robust when dealing with different types of materials, equipment, and people coming in and out of the Clubhouse.</p>	ownership of as frequently as one month to annually (depending on usage of the room, etc) [12]
Minimize cost	<p>The design should follow the budget requirements placed by the client [3].</p> <p>The design should be selected and built to maintain the rest of the objectives as well as staying conscientious of the budget.</p>	The budget for space solutions should be below \$10,000 as outlined by the client. [3]

Table 5: *Storage Objectives of the Sussex Clubhouse Project.*

Storage Objectives	Goals and Description	Metrics
Durable and Robust	<p>Storage should withstand a range of heavyweight equipment and materials to lightweight materials. [3]</p> <p>There are many different types of clubs with a wide variety of storage needs [3].</p>	The frequency of storage items being damaged due to poor storage can be tracked every month for a year [3]. The goal is a low incidental rate every year [13].
Secure	<p>Storage should be able to hold and secure sensitive club items that only club leaders have access to. [3]</p> <p>Many clubs will have personal equipment and expensive gear that require safe storage while they are out of the Clubhouse.</p>	Security incident reports will track the number of incidents per month related to security. [14] We aim for 0 incidents a month from each club [3].

Flexible	<p>Storage should be easily adjusted to suit what each distinct club needs to store. [3].</p> <p>The storage should account for the changing needs and requirements of each club.</p>	Clubs should be able to reach a higher range of 22%-27% space utilization (as this is a warehouse standard, but we do not need to take into consideration workers and worker labour cost) [5] by calculating the total size of their storage, their inventory size, and the storage size.[5]
Minimize cost	<p>The design should follow the budget requirements placed by the client [3].</p>	The budget for storage solutions should be below \$10,000 as outlined by the client. [3]

### 5.3 Constraints

This section sets strict limits or boundaries for the design. The design must not exceed the constraints of the project.

Table 6. *Constraints of the Sussex Clubhouse project*

Constraints	Metrics
Must not continue renovations after the allotted time frame.	Renovations must be completed within 2 weeks in June, as per the request of the client [16].
Must not reach a maximum capacity of 20 people.	Metric of a maximum capacity of 20 people in the largest room of 22.21 m <sup>2</sup> [5]. Appendix H contains the dimensions for the largest room.
Must not deconstruct room confinements (doors, windows, ceiling, walls), as there is asbestos in the walls.	Due to the hazards, 0 deconstructions should occur [16].
Must not conflict with room designs initiated by the club.	0 items should be removed without the club's permission [3].

## **6.0 Idea Generation, Idea Selection and Alternate Designs**

This section outlines how we generated and selected ideas based on the project requirements. We used benchmarking, SCAMPER, and general brainstorming in our ideation process which were categorized into storage efficiency, space efficiency and mobility. Ideas were selected through a feasibility check, multi-voting, a graphical decision chart, weighted matrix, and a pugh chart.

### **6.1 Idea Generation Process**

This section describes the methods used to develop ideas for the Sussex Clubhouse redesign that satisfy the detailed requirements of the client. The idea-generation process began by coming up with 63 ideas through brainstorming and the utilization of the SCAMPER Table [Appendix E]. This list consisted of ideas conscious of improving the space and storage problems outlined by the client. The idea list was then completed with a specific description for each idea, making sure each idea outlines how it will solve the lack of space or allow for better storage within the rooms and storage area. A feasibility check was done to cut down to 48 realistic ideas. We then used a morph chart to combine these ideas to create individual solutions that attend to each function. This was necessary as there are many intricacies with this project (space and storage objectives), requiring various solutions tackling each area of concern for the client.

### **6.2 Idea Selection Process**

The team utilized various methods to select final 3 design solutions as shown in Figure 7.

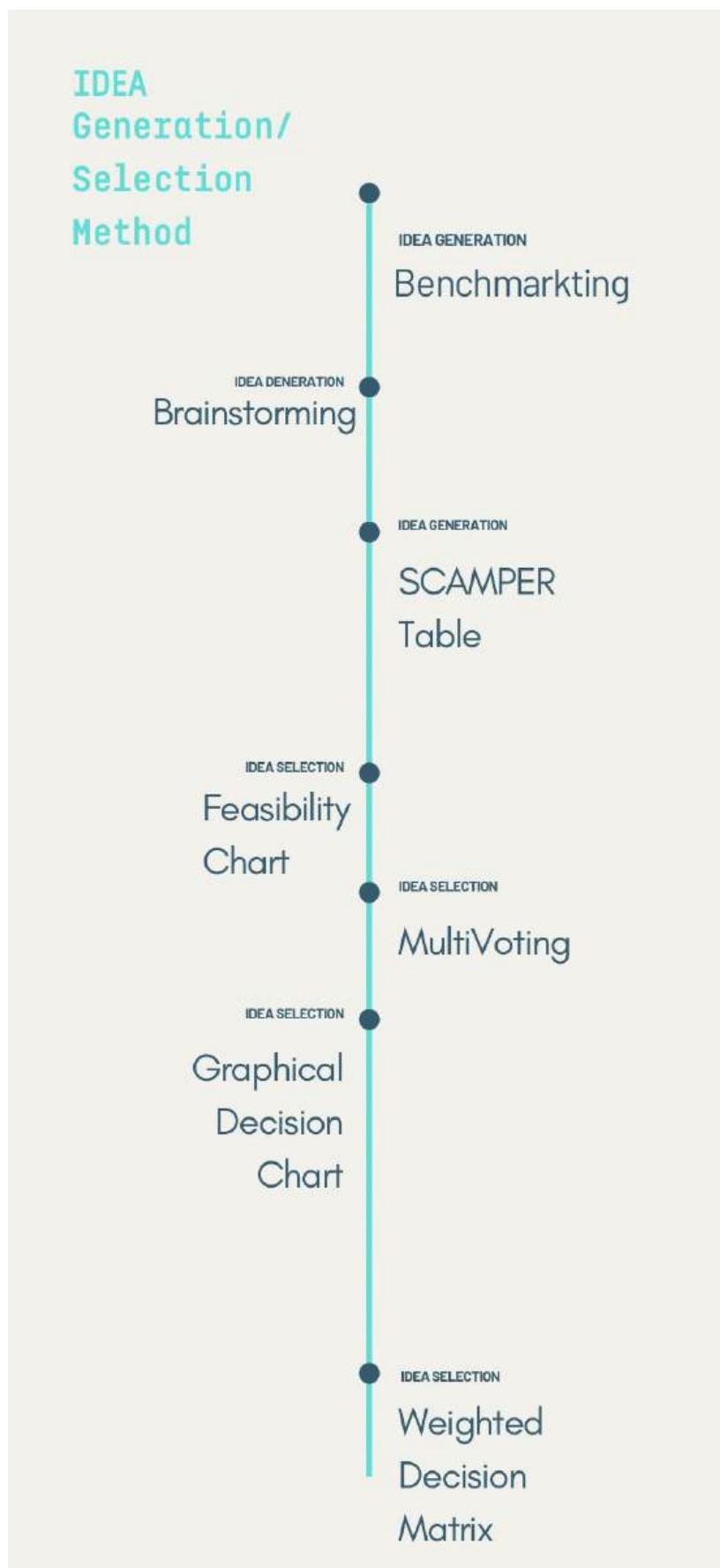


Figure 6. Flowchart: idea generation and selection process

The team began the idea selection process by using a feasibility chart to retain the most realistic ideas. Each idea was voted on based on predefined criteria including project relevance and practicality. Tied ideas were reorganized on a scale of 1-10 for a more precise assessment. This evaluation cut 63 ideas down to 48.

After the generation of 48 ideas through the morph chart, ideas were then evaluated based on multi-perspective preference[Appendix G], cutting 48 ideas down to 30.

A graphical decision matrix compared the two primary objective groups: storage and space objectives. This matrix displayed 15 ideas that did not meet our objectives. This evaluation cut 30 ideas down to 14.

## Space vs. Storage

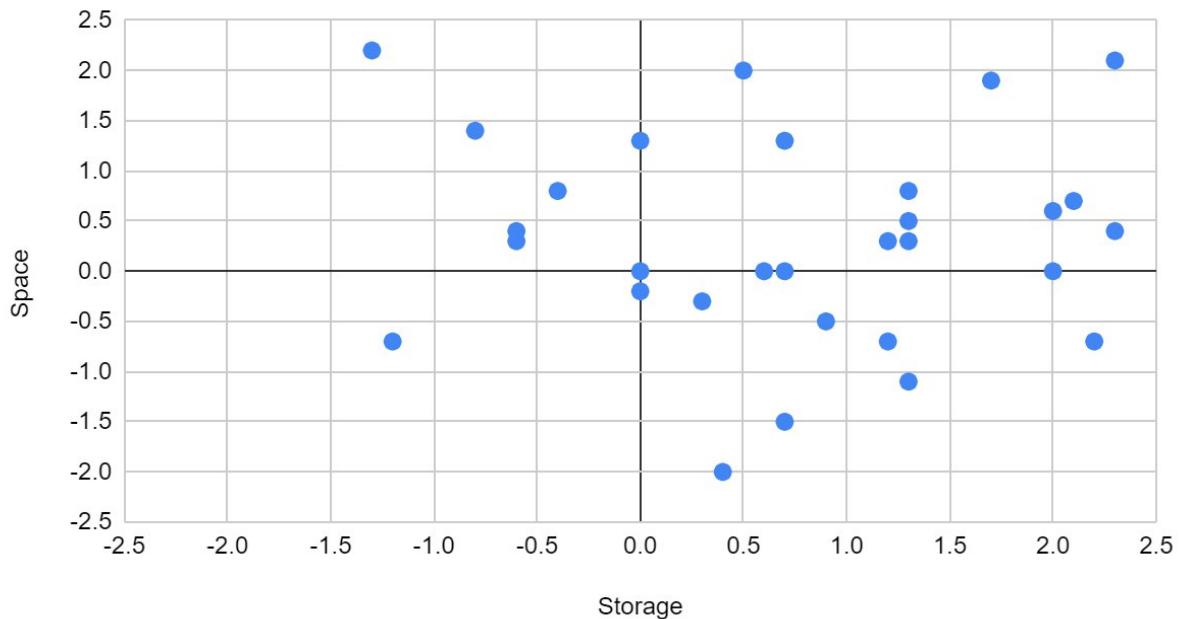
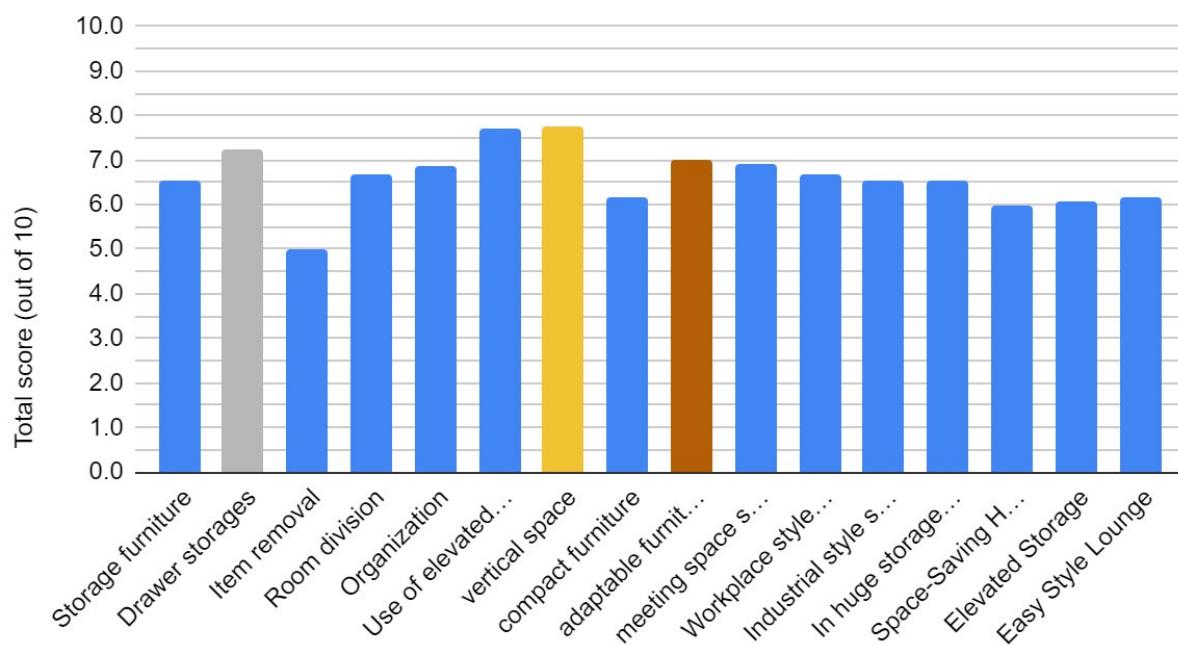


Figure 7. Graphical Decision matrix

To conclude the idea selection process and finalize three ideas, the team utilized their Objective Pairwise Comparison Charts [Appendix I]. The final weight for each objective was determined by calculating the percentage of its total score relative to the sum of scores for all objectives. The remaining 30 ideas were evaluated by assigning scores from 1-10 for how well each idea met

each objective. Scores were added up which led to the top three highest scored ideas as the three alternate ideas the team will propose to the client [Appendix J].

**Total score (out of 10)**



*Figure 8. Weighted decision matrix*

Themes such as space efficiency, storage and user experience were central to the ideation process. The team's diverse perspectives facilitated a comprehensive discussion over the merits and drawbacks of each design, ensuring the final selection was in alignment with the project's overarching goals.

### **6.3 Alternate Design Descriptions**

This section outlines the developed three designs that have been chosen to be the most suitable for the Sussex Space Audit Project. All blueprints and solution items are chosen based on the scaled layout of the room.

### 6.3.1 Design #1 - Vertical Space: “Aris”

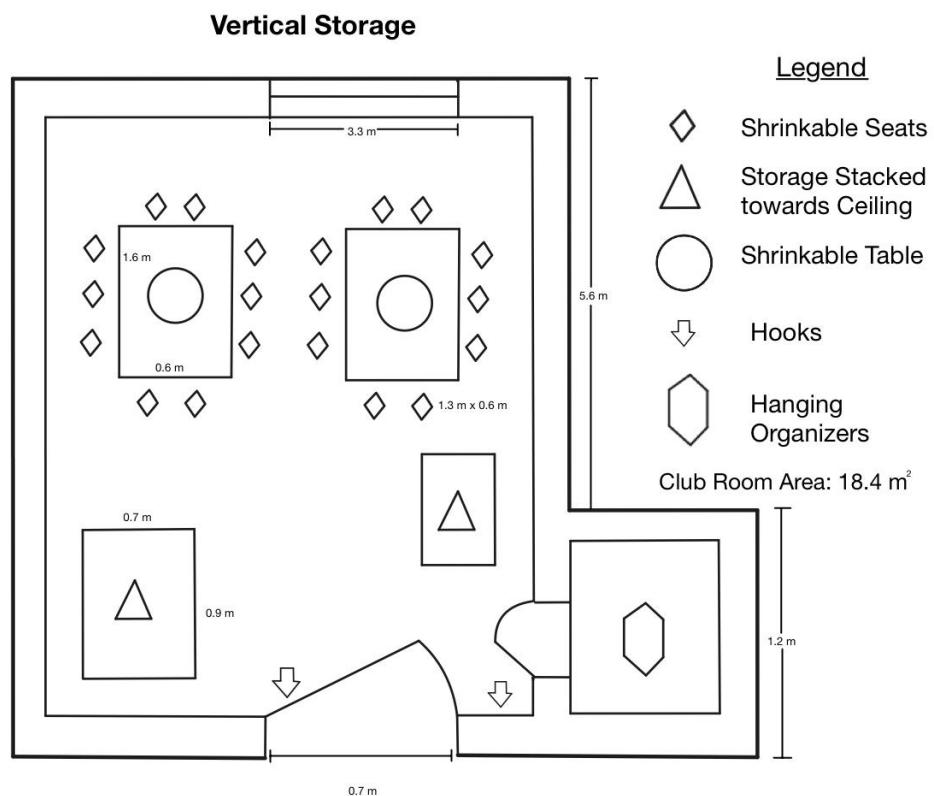


Figure 9. Vertical Space solution blueprint incorporated into the storage room and room 505 of the clubhouse.

Aris, the vertical space solution is designed to make use of elevated volumes of the room. The solution includes: stacking storage to a maximized height that is within reach with the use of a stepping stool, a hung storage system placed in the closet, hangers on doors, shelves placed along walls, shrinkable furniture and a division of the room between work and storage environments. In addition, this solution is an option for components in the storage room.

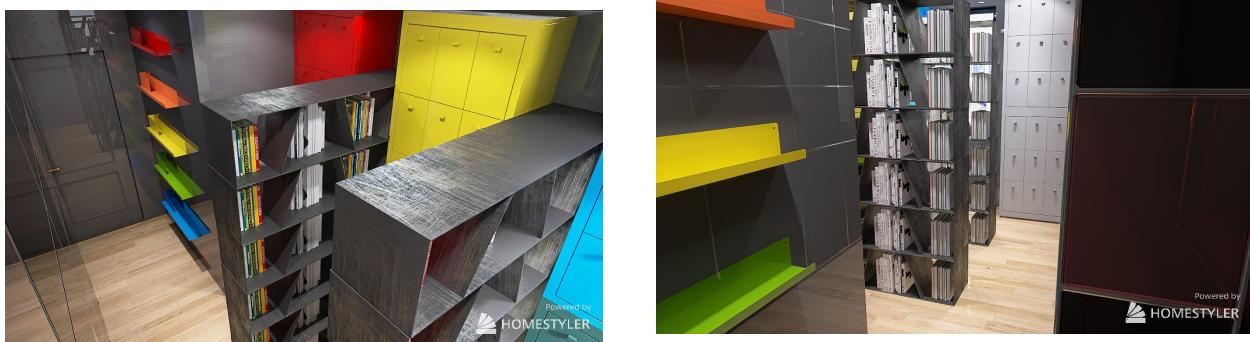


Figure 10. *Vertical space layout simulation in storage room made in Homestyler.*

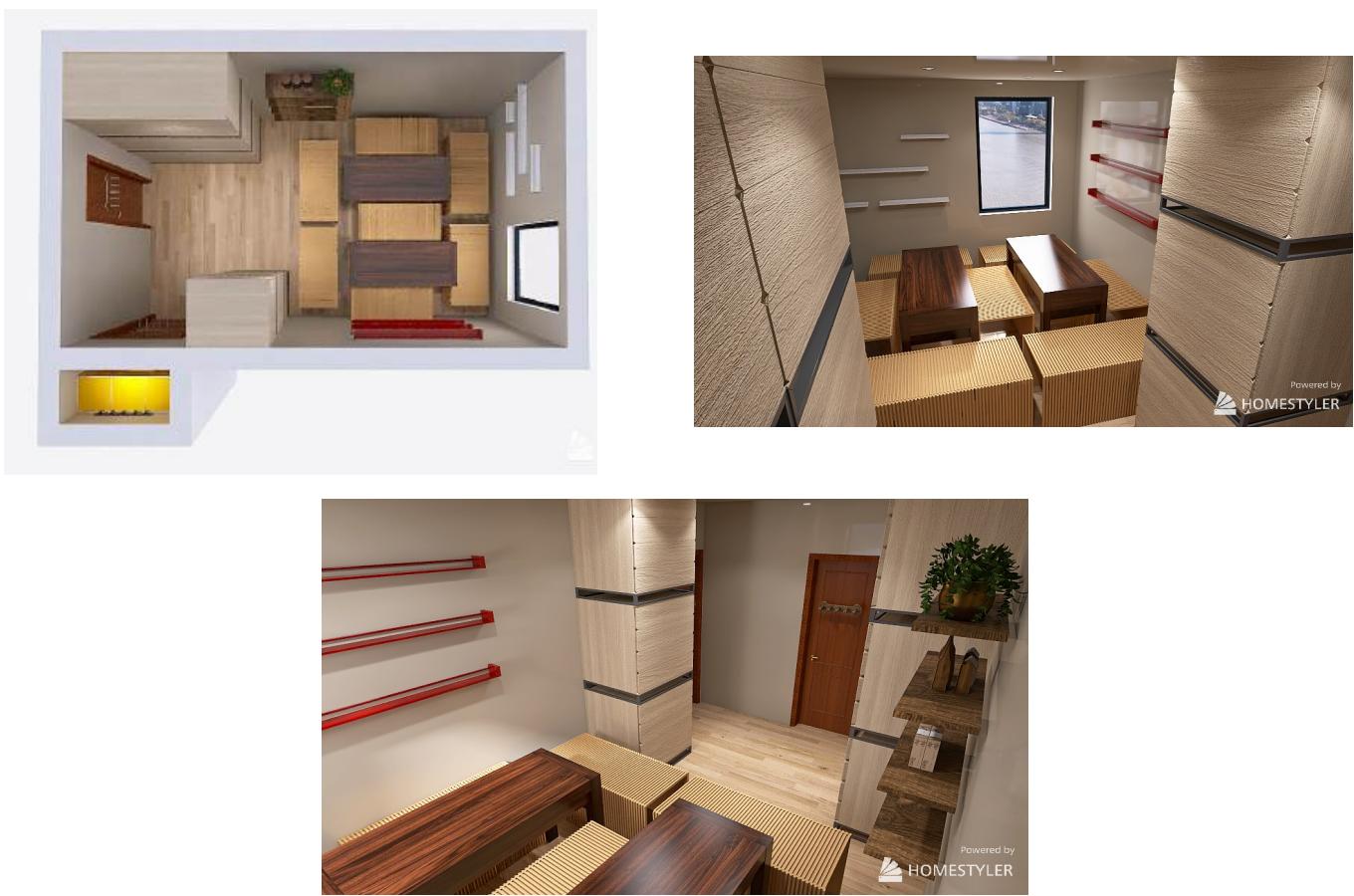


Figure 11. *Vertical space layout simulation in a Medium-sized club room made using Homestyler.*

Table 7. Objective Comparison of Aris.

Objectives	Description
Maximize utilization of space	As for a medium-sized club room, this space can fit well between 7-13 students by seating.
Adaptable Furniture	Furniture in this room contains an extra functionality of space-efficiency through its ability to shrink.
Minimize cost	Total budget cost: ranges from \$5700- \$6200 [Appendix O.] which is under budget.
Durable and robust	Sold furniture and storage items must be built to be durable by the Sale of Goods Act [22].
Secure	Color-coded systems and hung storage systems have lock systems however stacked storage drawers do not.

### 6.3.2 Design #2 - Drawer Storages: “Pandora”

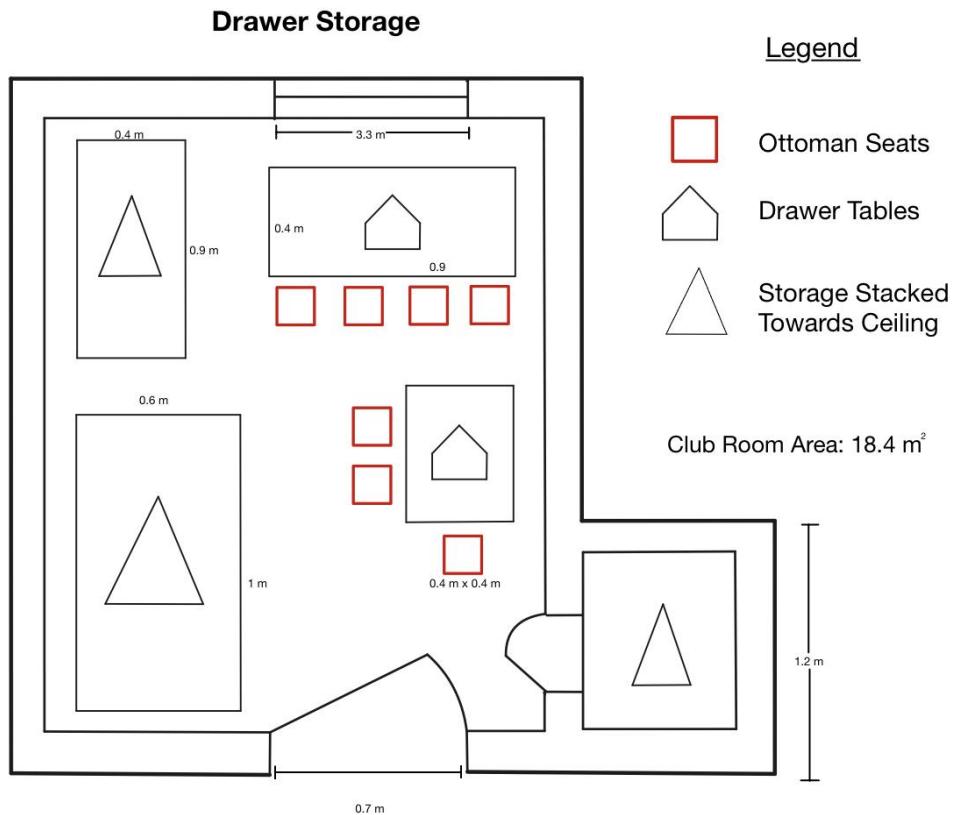


Figure 12. *Drawer Storage solution blueprint incorporated into room 505 of the clubhouse.*

Pandora, the drawer storage solution, uses drawers as a club room storage solution. The solution includes: drawer dividers that divide items by ranging sizes in drawers, tables with drawers, ottoman seats for storage underneath and the placement of items to surround people to avoid obstruction hazards.



Figure 13. *Drawer storage layout simulation in a small-sized club room made in Homestyler.*  
Table 8. Objective Comparison of Pandora.

Objectives	Description
Maximize utilization of space	This design can fit 1-6 students by seating in a small-sized room.
Adaptable Furniture	Furniture in this room provides storage space underneath seats and drawers.
Minimize cost	Total budget cost: \$3200-\$7000 [Appendix O] which is under budget.

Durable and robust	Sold furniture and storage items must be built to be durable by the Sale of Goods Act [22].
Secure	Ottoman seats and drawers are without a lock system. Does not pass this objective

### 6.3.3 Design #3 - Adaptable Furniture: “Proteus”

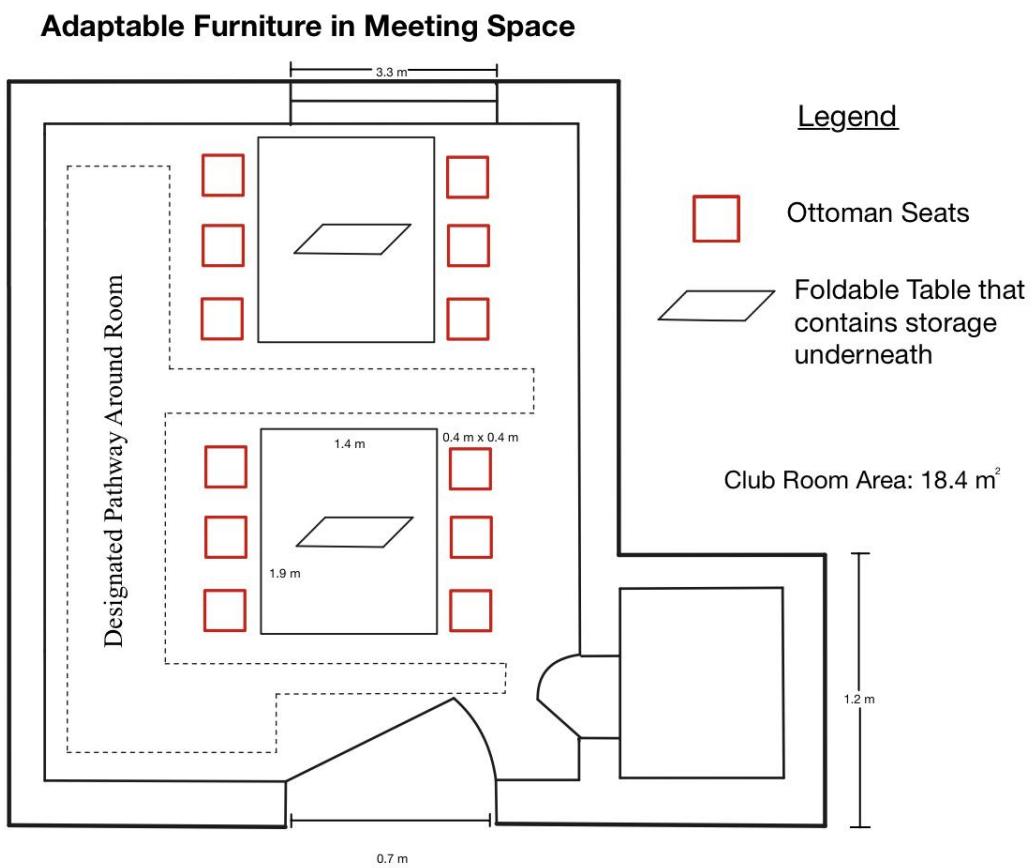


Figure 14. *Adaptable Furniture solution blueprint incorporated into room 505*

Proteus, the adaptable furniture storage solution, uses versatile furniture to attend to club's needs while having the storage capability. The solution includes ottoman seats and a table with storage

underneath, and an established designated pathway around the room that should not be stored with items.



Figure 15. *Adaptable furniture layout simulation in a big-sized club room made in Homestyler.*  
Table 9. Objective Comparison of Proteus.

Objectives	Description
Maximize utilization of space	This space can fit 14-20 students by seating in a big-sized room.
Adaptable Furniture	Furniture in this room provides storage spaces underneath seats and storage in tables.
Minimize cost	Total budget cost: about \$2200 [Appendix O] which is below budget.
Durable and robust	Sold furniture and storage items must be built to be durable by the Sale of Goods Act [22].
Secure	Tables with storage can have a lock system. Ottoman seats do not have a lock system.

## 7.0 Proposed Conceptual Design

To determine which design to recommend to the Client, we have implemented the Pugh method to select the final 3 ideas. “Space Saving Home Office” idea, which included Stairs that lead to

higher storage + Nesting Cabinets inside walls + Wall-Mounted Drop Leaf Table + Ottoman seats (storage under the seat), was used as a baseline for the solution comparison. This section presents why the team chose the given design.

Table 10. *Pugh Method Chart*

Base Idea: Space-Saving Home Office	Stairs that lead to higher storage + Nesting Cabinets inside walls + Wall-Mounted Drop Leaf Table + Ottoman seats (storage under the seat)					
	Maximize utilization of space	Adaptable Furniture	Minimize cost	Durable and robust	Secure	Total score
Space-Saving Home Office	0	0	0	0	0	0
Vertical space	2	1	0	1	1	5
Drawer Storages	1	-1	1	1	1	3
Adaptable furniture in meeting space	1	2	0	-1	-1	1

After reviewing the results of the Pugh chart, our team has concluded that Design #1: Vertical Space, which focuses on maximizing vertical space utilization, best fits the clients needs. This design allows for the space to be utilized for more club meetings and provides adequate room for storage. Mindful of client constraints [3] as well as Ontario building codes [5], this design will revitalize the Clubhouse by encouraging collaboration and team creativity through creating more floor space for club members and increasing versatile storage to place on the walls. This idea is also in line with the objectives as it is durable and robust using racks, shelves and hooks to increase storage options. This design focuses on maximizing floor space in order to bring more people into the clubhouse, allowing for a revival of the original functions of the clubhouse. The design as a whole is flexible and can be adapted to fit each club's needs and changing requirements.

## 8.0 Measures Of Success

To establish whether or not the suggested solution will cater to the client's needs, success metrics must be defined. This section suggests a viable test plan that can be completed in no more than four weeks to support the suggested design proposal.

The results of this series of tests will provide us with a sufficient assessment of the success of the storage space redesign as an evaluation of a space's strengths, as well as its intended and actual uses being measured which is viable according to LinkedIn [27].

Scaled models of our “Vertical Space” proposed conceptual design will be presented to the client in the third client meeting. This will visualize the design plan, ensuring the incorporation of designs into each club room. A model will be created to represent possible implementations in the storage room and a medium sized club room within the Sussex clubhouse.

To test the “livelihood” in the clubrooms, Margaret Chen will send a survey [Appendix O] to the club occupying the room for redesign, which will be conducted 4 weeks after the redesign is implemented. We will measure how successful our design is based on the club users' feedback.

We have also sent out a survey collecting feedback on how clubs feel about the current usage of space in the clubhouse. This can add additional support when comparing the “before” and “after” of implementing our design. Dora Lyu will collect all of the data via Google Survey 4 weeks after the survey has been sent out.

Matthew Ting and Anjali Jammulamadaka will calculate the additional space after the implementation of the design **which will provide a quantitative indication on the success of the space objective.**

Lydia Messiha and Chris Yip will calculate the additional storage after the implementation of the design **which will provide a quantitative indication on the success of the storage objective.** One week after the redesign is implemented, the final comparison tests will take place, this is to account for possible maneuvering of the redesign's layout.

## **9.0 Conclusion**

The comprehensive review of the Sussex Clubhouse Space Audit has led to the identification of the issues at the Sussex Clubhouse and three alternate solutions. Through rigorous evaluation, the Aris Vertical Space solution is deemed the most feasible in terms of its maximization of space, versatility, durability, cost, and security. The team is now ready to present this design and test plan to gain valuable feedback from the client. This will help us validate the efficacy of the chosen design before its full-scale implementation.

## 10.0 Citations

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[16] Engineering Notebook Notes

February 5<sup>th</sup>, 2024 Client Meeting 1

My questions:

3) can we have a master list of all club hours, content, leader info, number of members, floor plan, or where can we find one?

(e) is there any room/area/furniture/setup that should remain unchanged?

Focus on Floor 4, 5, & 6

- ↳ 6<sup>th</sup> floor rooms very small
- ↳ use as storage spaces

go back to pre-pandemic

vibe: more student life.

- no tearing walls down: asbestos is in the walls
- floor plans will be sent to us

Clubhouse busiest time:

late afternoon - evening

- renovations will be done 2 weeks in June

◦ Budget: Central Student Life

↳ budget already established

↳ \$2500 → tier 1

↳ \$5000 - \$7000 → for next year

↳ \$10,000 → Next 2 years, very unlikely

Suggestions about usage  
of the space

- lockers as storage have been successful

◦ Accessibility:

↳ find suggestions to improve

↳ 6<sup>th</sup> floor not accessible

↳ washrooms not accessible

↳ 3<sup>rd</sup> floor washrooms accessible

↳ want one on the 5<sup>th</sup> floor

Prayer Space

↳ liven up room: plants?

Anime / Origami

• not much renovation needed

Volleyball parties

↳ more social club

↳ back what they want?

DATES Available:

◦ Thursday, Feb 15<sup>th</sup> 11 - 3 pm

◦ Friday, Feb 16<sup>th</sup> 1 - 2 pm

◦ Monday, Feb 26<sup>th</sup> 10 - 11 am

Rm 610: Black Student Club

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<https://ayerssaintgross.com/work/space-analytics/space-assessment-and-analysis/> try this or this
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## 11.0 Appendix

### APPENDIX A. Myhal Center: Benchmarking - Margaret & Dora

Benchmarking: Myhal Centre for Engineering Innovation and Entrepreneurship

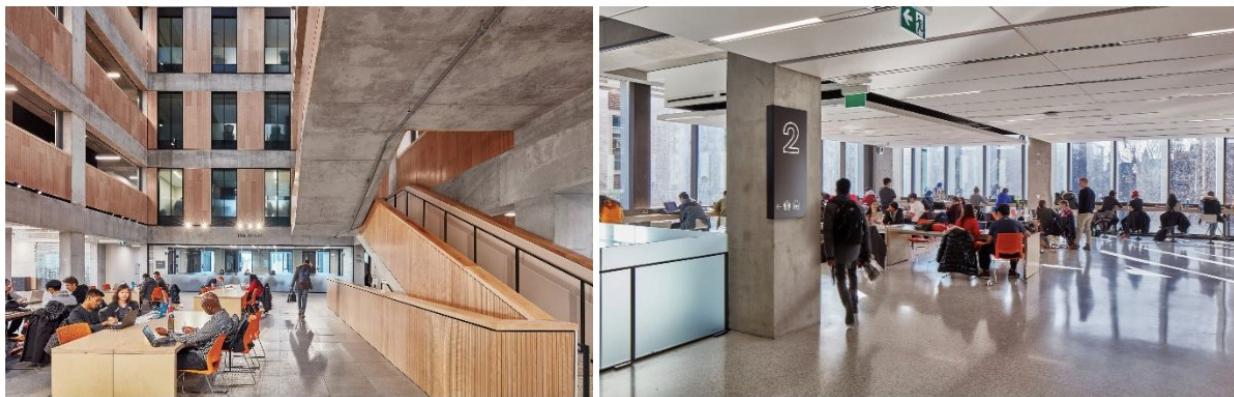


Figure 16. *Myhal Centre Collaborative Spaces (the fifth floor)*

The Myhal Centre is designed to enhance engineering education and research, fostering collaboration among students, researchers, and industry partners. The facility boasts state-of-the-art prototyping facilities, multidisciplinary research hubs, design studios, and technology-enhanced learning spaces. Its open and flexible spaces encourage interaction and innovation, setting a new standard for engineering education facilities.

Table 11. *Myhal Centre Storage Observation.*

Figure(s)	Description
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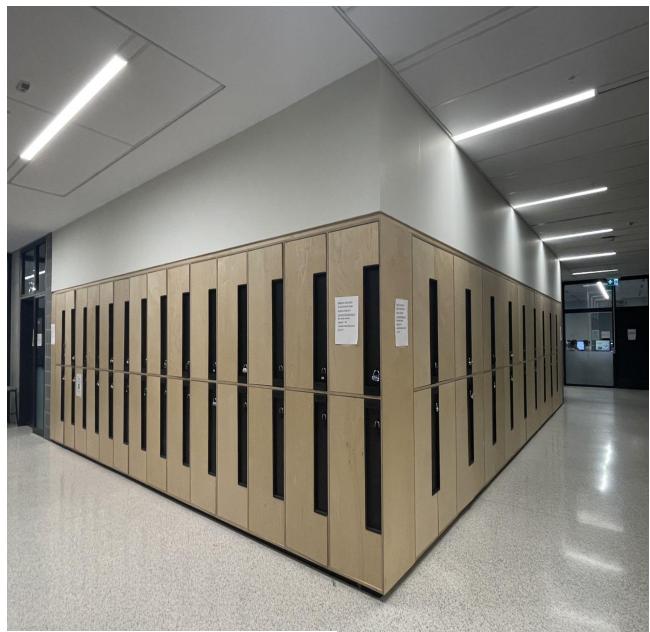


Figure 17. *Myhal lockers*

- The integration of lockers into the wall structure represents an intelligent design solution that significantly enhances space efficiency within the corridor.
- The extensive deployment of numerous lockers ensures ample personal storage capacity.

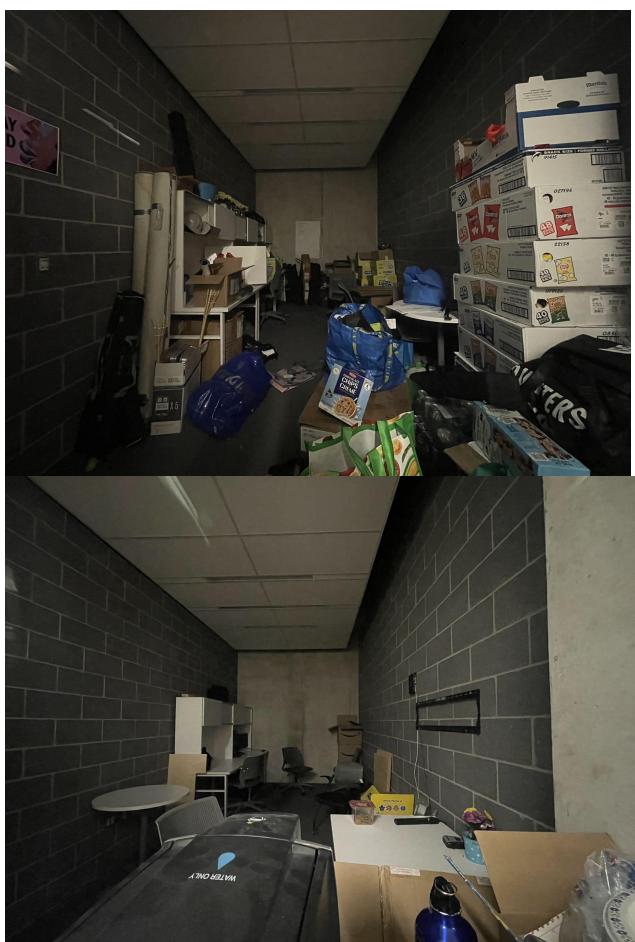
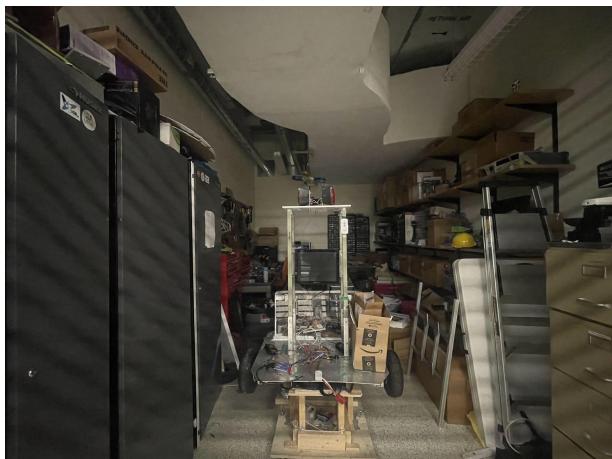


Figure 18. Storage area for Myhal

- These are examples of underutilization of space. Lots of clutter piled up on the floor, while there is still plenty of free space on the shelves and desks.



- The storage room pictured here has a number of display shelves, organizers and bookcases to categorize the large amount of clutter in the storage room.
- In addition to traditional ways of organizing, there is a use of tool wall organizers to save ground space.

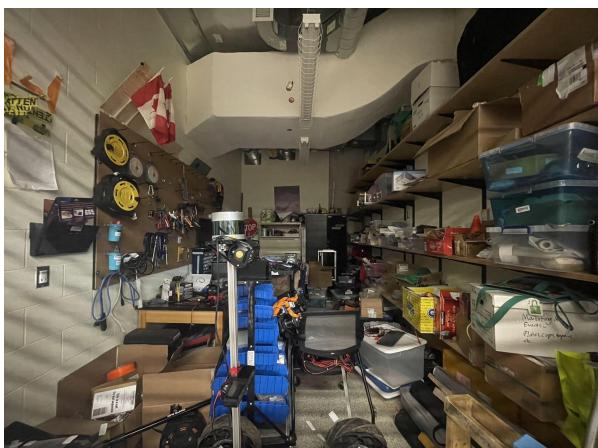


Figure 19. Storage area for Myhal

Table 12. Pros and Cons of Myhal Centre Design

Pros	Cons
<ol style="list-style-type: none"> <li>1. Encourages collaboration through open spaces</li> <li>2. Supports innovation with state-of-the-art facilities</li> <li>3. Flexible design accommodates various activities</li> <li>4. Multifunctional use for different areas</li> </ol>	<ol style="list-style-type: none"> <li>1. High-tech features may increase operational costs</li> <li>2. Open spaces might require more effective noise management strategies</li> </ol>

Table 13. Space Objective Assessment.

Space Objectives	Goals and Description
Maximize utilization of space:	The design optimizes space for a variety of uses, from individual study to large collaborative projects.
Maximize utilization of space:	The flexible layout can easily be adjusted to meet the evolving requirements of users and technological advancements.

Table 14. Storage Objective Assessment.

Storage Objectives	
<b>Innovative storage solutions:</b>	Utilizes smart storage solutions for equipment and materials, ensuring easy access without compromising space functionality

The Myhal Centre for Engineering Innovation and Entrepreneurship represents a significant advancement in engineering education and collaborative research. By comparing it to other spaces like the Sussex Clubhouse, it's evident that the Myhal Centre's design prioritizes flexibility, innovation, and collaboration. Its state-of-the-art facilities and open spaces encourage interaction among students, researchers, and industry partners, setting a new benchmark for academic and research institutions. The Myhal Centre's approach to maximizing space utilization and fostering an environment conducive to innovation offers valuable insights for enhancing our design's multi functionality and user experience.

#### APPENDIX B. Gerstein Library: Benchmarking - Written by Matthew

Benchmarking: Gerstein Library

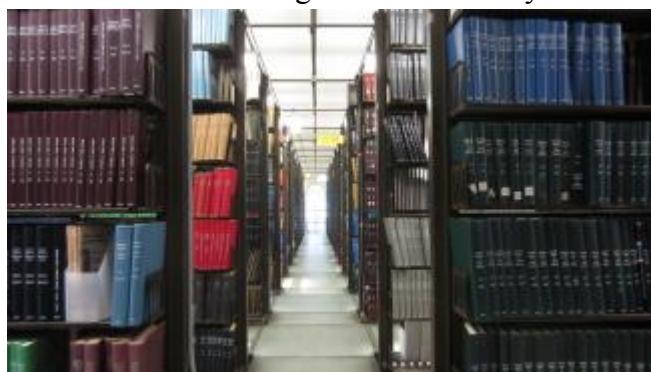


Figure 20. Gerstein Library Bookshelves stacked to the ceiling

Gerstein Library is a student space to study and read. Students will go to Gerstein for a general quiet space on campus. Books and documents are stored along the shelves with hallways that help users easily access each row. Unlike the Sussex Clubhouse, the library has a bigger area and height for storage options but provides a helpful component to our brainstorming process. Books are stacked to the ceiling which allows for less shelves to interfere with the accessible walking space.

Table 15. *Gerstein Library Measurements.*

Bookshelf Height: 2.28m	Bookshelf Width: 0.38m	Bookshelf Length: 14.25m
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Height of Library of Figure X: 2.52m	Width of walkway: 0.7125m	Time it takes to move around the and cover 4.75m x 2.25m of storage space: 6.72s
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Our final solution should incorporate this solution as rearranging storage for better walkspace considers two major functions: the solution component gives a better storage option while helping people walking around the space in a more efficient way.

Although this solution is present in Gerstein Library, it is good to give a good assessment on the solution and how well it can be incorporated into our solution.

Table 16. *Pros and Cons of Gernstein Library solution.*

Pros	Cons
<ul style="list-style-type: none"> <li>- Very accessible through hallways that can go through each piece of storage</li> <li>- Each piece of storage is visible</li> <li>- Better use of volume of the room</li> </ul>	<ul style="list-style-type: none"> <li>- Hallways are narrow</li> <li>- As each shelf is stacked to the ceiling, their is less space for wall design</li> <li>- Storage might be a bit harder to access with items stored at a more elevated level</li> </ul>

Table 17. *Space Objective Assessment.*

Space Objectives	Goals and Description
Maximize utilization of space	As this solution is more fitted as a storage improvement, this solution maximizes storage space which leaves other rooms emptier for space that students can use, improving the area of space students can use.
Adaptable furniture	As more space is freed from a storage improvement, there is more space around furniture for different activities

Table 18. *Storage Objective Assessment.*

Storage Objectives	Goals and Description
--------------------	-----------------------

Durable and Robust	Rearrangement of the cabinets will not affect the material that crafted the cabinet
Secure	Rearranging cabinets does not change the security of the cabinet.
Flexible	Cabinets have a volumetric storage space which allows for storage of all sizes.
Minimize cost	This does minimize cost as the storage room already includes storage cabinets that can be rearranged. This would require minimal to no cost as this solution only rearranges the storage space.

In conclusion, the Gerstein Library has provided a significant contribution to the storage issue as in contrast to the library, the clubhouse does not maximize the elevated areas of each room which can be used for storage. There is a big difference between the areas that people can walk through but an investigation on a similarly-purposed space helps the process for finding a solution to the Sussex Clubhouse Space.

#### **APPENDIX C. Dry Cleaner: Benchmarking - Written by Dora & Matthew**

##### Benchmarking: Dry Cleaner

A dry cleaner layout is usually designed to optimize employee productivity and space use efficiency through planning the arrangement of equipment and the flow of work. In this situation, the use of automated transmission machines is adapted to transport, sort, and store garments.



Figure 21. Display of clothes on rack of dry cleaning system

### Solution

Automated Transmission Machine (Automated Garment Conveyor System)  
Description

This system consists of a motorized conveyor track equipped with hooks or slots where garments can be hung and automatically moved to different stations for processing or storage. This technology allows dry cleaners to manage a great amount of clothing items in an orderly and efficient manner.

Table 17. *Pros and Cons of Dry Cleaner solution.*

Pros	Cons
<ul style="list-style-type: none"> <li>- Saves space from the remove of the need to walk around through each cabinet</li> <li>- Easily access any storage unit through the hold of a button</li> </ul>	<ul style="list-style-type: none"> <li>- Could be costly due to springs and levers that require metal parts</li> <li>- Requires mechanical energy to operate</li> <li>- Requires regular maintenance updates and check ups</li> </ul>

Table 18. *Space Objective Assessment.*

Space Objectives	Goals and Description
Maximize utilization of space	Saves walking space in storage room as system uses rotational sp
Adaptable furniture	This solution is to be incorporated into the storage room directly

Storage Objectives	Goals and Description
Durable and Robust	The material of this transmission system should be stiff enough and requires con maintenance.
Secure	These cabinets are stored so close to each other that it is impossible to open until from the machine, the button to cycle cabinets will have a lock
Flexible	Users get easy access to specific clothing wherever it is stored with the automatic system

Table 19. *Storage Objective Assessment.*

Conclusion (comparison)

The use of Automated Transmission System in a Dry Cleaner aims to optimize the utilization of limited space and increase efficiency in retrieving items, which is exactly the same need for the Clubhouse redesign. But this system requires a high building cost and is probably still too large for the storage room size provided in Clubhouse.

#### APPENDIX D. Hart House: Benchmarking - Written by Lydia & Anjali

## Benchmarking: Hart House

Hart House is a student-focused center that houses many different expressions of student arts, wellness, and dialogue. Hart House allows unique ways for students, faculty, alumni and the broader community to connect and engage with one another. The facility includes a wide range of rooms for studying, dining, recreation, and socializing.

Despite their being small meeting rooms in Hart House, they are designed in a way that fosters community between students, creating a lively environment.

*Table 1: Pros and Cons of Hart House*

Pros	Cons
<ul style="list-style-type: none"> <li>- has many different rooms and allows for a wide variety of student groups to meet and collaborate</li> <li>- Room sizes vary allowing for small meeting and studying rooms (5-10) and large rooms that allow for 30-50 people</li> <li>- Allow for storage of different materials like sporting equipment, food, instruments, books, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- the building is slightly disorganized which can allow for clutter with no systematic process of where things need to be placed</li> <li>- there is not overall community within Hart House and more separate small communities that come in and out each day</li> <li>- It can be difficult to navigate Hart House and understand where everything is and where certain rooms with specific functions are.</li> </ul>



Figure 22. Rooms in Hart House

*Table 2: Space Objectives of Hart House*

Space Objectives	Description
Maximize utilization of the space	Various spaces within Hart House hold student gatherings to foster community, collaboration and creativity. The goal is to have a building that brings people together. Rooms are organized, creating space for students and faculty to gather properly without having any obstacles such as misplaced items, etc.
Universal Usage of Furniture	Hart house utilizes many different furniture options, making it easy to cater a room to your needs. They have foldable chairs and tables as well as chairs and tables with wheels that can move to however the user likes.

Table 3: Storage Objectives of Hart House

Storage Objectives	Description
Secure	Hart House has storage cabinets that are locked up so no one without a key can access what's inside.
Durable and robust	Hart House has storage for all different types of materials, such as sports equipment, books, important documents, and even food. They are equipped to store all different types of materials well.



Figure 23. Cabinets and Storage in Hart House.

Function: Provide free meeting and work spaces for clubs and the staff of the University of Toronto and bring more students into the clubhouse and construct a more lively space.

*Table 4*

Form	Flow
The Hart House meeting rooms, despite their size, provide an efficient and lively space for students to meet and socialize. Some rooms are large rooms for meetings while some are smaller. Hart House is equipped with various types of storage units.	Mass: UofT Students and Staff in and out. Items in and out of storage units.  Energy: Lighting  Information: Student/staff meetings
Analysis: There are durable and spacious storage units in place as shown in Figure 2. They are portable since they are equipped with wheels. The storage units are sturdy as they are made of wood. The units are spacious and can store a significant amount of items.	

Hart House is an excellent example of the environment the client wants to recreate at the Clubhouse. A friendly environment that fosters collaboration, creativity, and group work through the utilization of large meeting spaces with adequate storage, as well as smaller meeting rooms for more intimate meetings. Hart House has many different types of storage units as well, and there is always somewhere to gather people, be on your own, or store important material.

#### **APPENDIX E. SCAMPER Table**

Table X. *SCAMPER table that used the SCAMPER method to generate ideas based off of the designed problem. Additional brainstormed ideas were added here.*

Storing efficiently	Space efficiency: Adaptable Furniture	Mobility: Transportation around the room
Storage room	Storage for club room	

Bigger Cabinets	Storage under foldable couch	Foldable Tables/Desks	Designated pathways around the room
Renting a storage unit	Storage under box seats	Chairs that have wheels	Rearrange items to surround people
Incorporating baskets and large nets on the ceiling to hold material	Storage in vertical space:racks or shelves	Chairs that are stackable and can fold	Divide room into work and storage place
Allowing for general storage + locked up storage	Reduce the one-time purchase of consumables	Ottoman-style seats (can hold items)	Limit amount of stuff allowed to be stored by each club in the rooms
Elevated storage units	Hanging organizer in the closet	Expandable chair	
Stairs that lead to higher storage	Hooks on the doors	Lift top tables	
Drawer Dividers	Include more desks with drawers	Shrinkable sofa with storage space	
Stackable Bins	Tables or chairs with build-in drawers	Expandable shelves	
Drawer+Stairs that lead to higher storage	Snacks store in the public kitchen	Lockers with insertable shelves	
Underfloor Space	Disposable recyclable storage	Wall-Mounted Drop Leaf Table	
Nesting cabinets inside walls	Rolling storage carts	Rotating Storage	
Automated Transmission Storage Units	Stackable shelves	Fold-Down Wall Desks	
Honeycomb Structure Cabinets	Minimum the size of furniture	Bed Risers	
Sleeve Storage	Multi-Purpose Furniture	Centrepiece items are placed in center	
Rip down all lockers and redesign	Bookcases with Doors	Use of all sides of furniture (e.g. table)	

Implement a system for tracking and reporting facility maintenance issues		Magnetic Levitation Furniture	
Sustainable storage options, such as recycled materials or repurposed furniture.	removing table (meeting area)	nesting furniture	
Implement a color-coded system for organizing storage areas based on group affiliation.	Second floor for storage	ceiling hung hammock chairs	
Install lockers with built-in ventilation systems for storing athletic gear or uniforms.	Corner bench with hidden storage	Install privacy screens or dividers in shared workspaces (2 club rooms)	
	Corner shelves	Floor seating pads	
	Host regular clean-up days to declutter shared spaces and optimize storage efficiency.	Puzzle seating	
	Offer incentives for groups to donate unused items to charity or recycling programs.	Shrinkable/collapsible furniture	
	Create a digital marketplace for buying, selling, or trading group resources and equipment.	smaller furniture	
	Underground storage		

## APPENDIX F. Idea list

Table X. General idea list that was used to create the morph chart. These ideas were created in the brainstorming and benchmarking idea generation process.

	Idea	Description	Idea type	Idea Generator
Storage Room	Stack storage to ceiling	Storage cabinets are stored in a more elevated area that is currently unused	SCAMPER +Bench	Matthew
	Dry Cleaning Garment Conveyor belt	Conveyer belt that holds storage cabinets and rotates around the room	Bench	Matthew
	Layered floor tiles	Additional layer that acts as walking space that can also be used for cabinets	Brainstorming	Matthew
	Item sort and filter	Item are stored in one big cabinet and are scanned for each item name, item's are then requested by machine and brought to user	Brainstorming	Matthew
	Bigger Cabinets	Self-explanatory	Brainstorm +SCAMPER	Chris
	Renting a storage unit	Self-explanatory	Brainstorm +SCAMPER	Matthew
	Incorporating baskets and large nets on the ceiling to hold material	self explanatory	Brainstorm +SCAMPER	Lydia
	Allowing for general storage + locked up storage	if we allow for both general and locked up storage (which could be like a designated	Brainstorm + SCAMPER	Lydia

		room for all of the very special storage that is not accessed as frequently) this can reduce clutter		
	Elevated storage units	Cabinets and other storage units are used to roof	SCAMPER +Bench	Matthew
	Stairs that lead to higher storage	Storage on ceiling with stairs that can access (act as upper floor)	Brainstorm +SCAMPER	Matthew
	Drawer Dividers	Self-explanatory	Brainstorm +SCAMPER	Chris
	Implement a system for tracking and reporting facility maintenance issues	system could be digital for each room or a physical form	Brainstorm +SCAMPER	Lydia
	Sustainable storage options, such as recycled materials or repurposed furniture.	this can help with cost as well as using what we already have	Brainstorm +SCAMPER	Lydia
	Implement a color-coded system for organizing storage areas based on group affiliation.	this can help with getting storage for different types of things and will help us organize different storage that we need to design (heavy things vs sports vs paper, etc)	Brainstorm +SCAMPER	Lydia
	Install lockers with built-in ventilation systems for storing athletic gear or	Self explanatory	Brainstorm +SCAMPER	Lydia

	uniforms.			
	Bookcases with Doors	Separate the items	Brainstorming	MC
	Build new storage units	no explanation needed	Brainstorming	MC
	removing table (meeting area)	no explanation needed	Brainstorming	MC
	Second floor for storage	Add a partition above the room to hold items that can be climbed with a ladder	Brainstorming	Dora
Storage Club Room	Underfloor Space	higher the floor and add a compartment under it, use the compartment for storage	Brainstorming	Dora
	Nesting cabinets inside walls	like what the Myhal basement did for storage	Brainstorming	Dora
	Automated Transmission Storage Units	a transmission belt can transmit objects out from anywhere in the cabinets	Brainstorming	Dora
	Honeycomb Structure Cabinets	Honeycomb construction maximizes weight capacity and make the fullest use of space.	Brainstorming	Dora
	Sleeve Storage	It's a sliding door design, when not in use it can be set together,	Brainstorming	Dora

		when you need to use it can be unfolded. See pictures posted in dc		
	Storage under foldable couch	Self-explanatory	Brainstorm +SCAMPER	Matthew
	Ottoman-seats (storage under seat)	Self-explanatory	Brainstorm +SCAMPER	Anjali
	Storage in vertical space:racks or shelves	rack or shelves	Brainstorm +SCAMPER	MC
	Hanging organizer in the closet	no explanation needed	Brainstorm +SCAMPER	MC
	Hooks on the doors	no explanation needed	Brainstorm +SCAMPER	MC
	Include more desks with drawers	no explanation needed	Brainstorm +SCAMPER	MC
	Tables or chairs with build-in drawers	no explanation needed	Brainstorm +SCAMPER	MC
	Snacks store in the public kitchen	no explanation needed	Brainstorm +SCAMPER	MC
	Disposable recyclable storage	no explanation needed	Brainstorm +SCAMPER	MC
	Rolling storage carts	A rolling cart that store items that can be moved around	Brainstorm +SCAMPER	MC
	Stackable shelves	Shelves are stack to conserve floor space	Brainstorm +SCAMPER	MC
	Multi-Purpose Furniture	Furniture that used for different purposes	Brainstorm +SCAMPER	MC
	Corner bench with hidden storage	bench in the corner that can lift up to store items	Brainstorm +SCAMPER	Anjali
	Host regular clean-up days to declutter	description is self	Brainstorm	lydia

	shared spaces and optimize storage efficiency.	explanatory	+SCAMPER	
	Offer incentives for groups to donate unused items to charity or recycling programs.	self explanatory	Brainstorm +SCAMPER	lydia
	Create a digital marketplace for buying, selling, or trading group resources and equipment.	self explanatory	Brainstorm +SCAMPER	lydia
Space Efficiency	Trash,donate or take home items that are unused	Solution is described in title	Brainstorming	Matthew
	Centerpiece is placed in center	Any room items that are generally used more have centered furniture around it	SCAMPER	Matthew
	Use of all sides of furniture (e.g. table)	Some rooms have sides of furniture that are unused that can be used through furniture arrangements	SCAMPER	Matthew
	Magnetic levitation furniture	Use the principle of magnetic levitation to make all the furniture in the room floats in the air. Actually kind of save in ground space and increase its mobility.	Brainstorming	Dora
	Foldable Tables/Desks	desks and chairs that can be folded and stored away for more space	Brainstorm +SCAMPER	Anjali

	Chairs that have wheels	Self-explanatory	Brainstorm +SCAMPER	
	Chairs that are stackable and can fold	Self-explanatory	Brainstorm +SCAMPER	
	Lift top tables	tables that lift to have more storage underneath	Brainstorm +SCAMPER	Anjali
	Shrinkable sofa with storage space	Self-explanatory	Brainstorm +SCAMPER	Anjali
	Lockers with insertable shelves	if clubs need more shelves they can insert them in their designated locker space	Brainstorm +SCAMPER	Anjali
	Wall-Mounted Drop Leaf Table	Self-explanatory	Brainstorm +SCAMPER	MC
	Fold-Down Wall Desks	Self-explanatory	Brainstorm +SCAMPER	
	Bed Risers	Rises bed to have more space within the room	Brainstorm +SCAMPER	
	Use of all sides of furniture (e.g. 4 sides of table)	Self-explanatory	Brainstorm +SCAMPER	Matthew
	nesting furniture	Self-explanatory	Brainstorm +SCAMPER	
	ceiling hung hammock chairs	Self-explanatory	Brainstorm +SCAMPER	Anjali
	Install privacy screens or dividers in shared workspaces (2 club rooms)	Self-explanatory	Brainstorm +SCAMPER	
	Puzzle seating	Self-explanatory	Brainstorm +SCAMPER	Anjali
		Self-explanatory	Brainstorm +SCAMPER	Anjali

	Fold-Down Wall Desks	Desk set up on the wall and put it down when use it	brainstorm	MC
	Install Locker accessories	Explore accessories such as hooks, bins, or dividers that can be added to the inside of the lockers to maximize storage capacity and organization. These accessories can help utilize the available space more effectively.	Brainstorm +SCAMPER	Chris
Transport people	Designated pathways around the room	Pathways inscribed on the floor that are not allowed to be used for storage	Brainstorm +SCAMPER	Matthew
		Items are occupied on walls, open space at center for walking space	Brainstorm +SCAMPER	Matthew
	Limit amount of stuff allowed to be stored by each club in the rooms	Volume limit for storage	Brainstorm +SCAMPER	Matthew

- **Idea generation idea percentages (what percentage of ideas came from which idea generation methods)**
  
  
  
- **Score of ideas based on each idea generation method**
- **Feasibility chart votes**

## APPENDIX G. Multi-voting results

Multi-voting results were derived from the morph chart selection	Below are the final ideas that remain after the multi-voting idea selection method
Storage furniture	Stack Storage to ceiling+Ottoman-Seats+Shrinkable furniture with storage space+Designated pathways around the room
Drawer storages	Drawer Dividers+Sleeve storage+Table/Chair with drawer+Rearrange items to surround people
Item removal	Allowing for general storage and locked up storage + Incentive to donate items+Item Marketplace + Limit items allowed to be stored
Room division	Bigger Cabinets+Racks and Shelves+Clean-Up days+Wall Mounted DropLeaf table+Divide room into work and storage place
Organization	Color-coded system+Honeycomb cabinets+Stack storage to ceiling+Foldable chairs+Designated pathways around the room
Use of elevated space	Stack Storage to ceiling+Honeycomb Cabinets+Shrinkable furniture with storage+Divide room into work and storage place
Outside storage	General storage and locked up storage+rent storage unit+storage carts+Take home unused items+Nesting furniture+Limit items allowed to be stored
vertical space	stack storage to the ceiling with elevated storage units, implement hanging organizers in closets and use hooks on doors and walls and use racks and shelves along the walls
compact furniture	foldable tables, collapsible chairs, chairs with wheels, stackable chairs, shrinkable sofas with storage space, sofas that can store chairs, tables that have space to put chairs under
maximize floor space	layered floor tiles, floor seating pads, puzzle seating for flexible arrangements, designated pathways around the room
maintenance and sustainability	implement a system for tracking facility maintenance, sustainable storage, disposable and recyclable storage, donate used items and offer incentives for clubs, digital marketplace, store food in public kitchen
innovation storage	automated transmission storage units, honeycomb structure cabinets, sleeve storage, storage under foldable couches, ceiling hung hammock chairs, implement bed risers

adaptable furniture in meeting space	Multi-Purpose Furniture + Foldable Tables/Desks + Ottoman-seats (storage under seat) + Incorporating baskets and large nets on the ceiling
meeting space storage	Tables or chairs with build-in drawers + Honeycomb Structure Cabinets + Sleeve Storage + Fold-Down Wall Desks
storage furniture	Wall-Mounted Drop Leaf Table + Remove table (meeting area) + Hanging organizer in the closet + Drawer Dividers
space saving	Tables or chairs with build-in drawers + Incorporating baskets and large nets on the ceiling + Fold-Down Wall Desks + Designated pathways around the room
Japanese minimalist model	Underfloor Space + Nesting cabinets inside walls + Bookcases with Doors + Corner bench with hidden storage + Install privacy screens or dividers in shared workspaces (2 club rooms)
Workplace style (office)	Hanging organizer in the closet + Include more desks with drawers + Rolling storage carts + Multi-Purpose Furniture + Corner shelves + Host regular clean-up days to declutter shared spaces and optimize storage efficiency.+ Chairs that have wheels + Wall-Mounted Drop Leaf Table
Industrial style storage room	Install lockers with built-in ventilation systems for storing athletic gear or uniforms. + Automated Transmission Storage Units + Host regular clean-up days to declutter shared spaces and optimize storage efficiency. + Sleeve Storage
In huge storage needs	Storage in vertical space:racks or shelves + Hanging organizer in the closet + Hooks on the doors + Multi-Purpose Furniture Corner bench with hidden storage+ Host regular clean-up days to declutter shared spaces and optimize storage efficiency.+ Expandable shelves Wall-Mounted Drop Leaf Table
Social gathering room	Foldable Tables/Desk + Ottoman-style seats (can hold items) + Shrinkable sofa with storage spaceWall + Rearrange items to surround people+ Mounted Drop Leaf Table
Efficient Office	Automated Transmission Storage Units + Honeycomb Structure Cabinets + Foldable Tables/Desks + Bed Risers
Active Learning Classroom	Ottoman-seats (storage under seat) + Multi-Purpose Furniture + Ceiling Hung Hammock Chairs
Collaborative Tech Lounge	Automated Transmission Storage Units + Foldable Tables/Desks + Wall-Mounted Drop Leaf Table
Active Break Room	Ottoman-seats (storage under seat) + Honeycomb Structure Cabinets + Puzzle Seating + Hanging Organizer in the Closet

Space-Saving Home Office	Stairs that lead to higher storage + Nesting Cabinets inside walls + Wall-Mounted Drop Leaf Table + Ottoman-seats (storage under seat)
Elevated Storage	Elevated storage units+Ottoman-seats (storage under seat)+Limit amount of stuff allowed to be stored by each club in the rooms
Green Lounge	Drawer Divider+Sustainable storage options, such as recycled materials or repurposed furniture+Rearrange items to surround people
Secret Storage	Bookcases with Doors+Bed Risers+Designated pathways around the room
Easy Style Lounge	Drawer Dividers+Hanging organizer in the closet +Limit amount of stuff allowed to be stored by each club in the rooms

## APPENDIX H. Graphical Decision Chart

Table X. *Graphical Decision Chart to assess ideas based off of our categorized objectives: storage and space*

Storage Vs. Space	Removed 15 ideas that were below 0 axis	Graphical Decision Chart rank ranges: 5 from [-2.5,2.5]		These ideas either fit storage but not space, space but not storage or neither
		Storage	Space	
Storage furniture		2	0	
Drawer storages		0.5	2	
Item removal		0	1.3	
Room division		0.6	0	
Organization		1.3	0.8	
Use of elevated space		2	0.6	
Outside storage		0.3	-0.3	
vertical space		2.3	2.1	
compact furniture		0.7	1.3	
maximize floor space		-0.8	1.4	
maintenance and sustainability		-1.2	-0.7	
innovation storage		1.2	-0.7	
adaptable furniture in meeting space		1.3	0.3	

meeting space storage		2.3	0.4
storage furniture		-0.4	0.8
space saving		0.9	-0.5
Japanese minimalist model		2.2	-0.7
Workplace style (office)		2.1	0.7
Industrial style storage room		1.3	-1.1
In huge storage needs		1.2	0.3
Social gathering room		-1.3	2.2
Efficient Office		-0.6	0.3
Active Learning Classroom		0	-0.2
Collaborative Tech Lounge		-0.6	0.4
Active Break Room		0	0
Space-Saving Home Office		0.7	0
Elevated Storage		1.3	0.5
Green Lounge		0.7	-1.5
Secret Storage		0.4	-2
Easy Style Lounge		1.7	1.9

## Appendix I Objective Pairwise Comparison Chart

Appendix E showcases a pairwise comparison chart between each objective to rank each objective by importance.

Table 11. *Space Objective Pairwise Comparison Chart*

	Maximize utilization of space	Adaptable Furniture	Minimize cost	Durable and robust	Total
Maximize utilization of space		1	1	1	3

Adaptable Furniture	0		1	1	2
Minimize cost	0	0		0	0
Durable and robust	0	0	1		1

Table 12: *Storage Objectives Pairwise Comparison Chart*

	Flexible	Secure	Minimize cost	Durable and robust	Total
Flexible		0	1	0	1
Secure	1		1	0	2
Minimize cost	0	0		0	0
Durable and robust	1	1	1		3

**APPENDIX J. Weighted Decision Matrix**

Table X. *Weighted Decision Matrix is the 4th step in our idea selection process. (Idea name: Use of elevated space is removed due to similarity, differing aspects of idea was combined)*

	Maximize utilization of space (30.77%)	Adaptable Furniture (23.08%)	Minimize cost (7.692%)	Durable and robust (15.38%)	Secure (23.08%)	Total score (out of 10)
Storage furniture	8	8	4	5	5	6.539
Drawer storages	8	7	8	6	7	7.231

Item removal	7	1	8	1	8	5
Room division	7	7	5	6	7	6.693
Organization	8	6	7	7	6	6.846
Use of elevated space	8	8	4	8	8	7.692
vertical space	8	8	5	8	8	7.769
compact furniture	6	8	4	5	6	6.154
adaptable furniture in meeting space	8	9	5	6	5	7
meeting space storage	8	8	4	6	6	6.923
Workplace style (office)	7	8	5	6	6	6.693
Industrial style storage room	6	5	4	9	8	6.538
In huge storage needs	9	4	3	8	6	6.538
Space-Saving Home Office	6	7	6	6	5	6
Elevated Storage	6	6	4	6	7	6.077
Easy Style Lounge	6	7	7	5	6	6.154

## APPENDIX K. Pugh Decision Chart

Pugh Chart:						
	Maximize utilization of space	Adaptable Furniture	Minimize cost	Durable and robust	Secure	Total score
Space-Saving Home Office	0	0	0	0	0	0
Drawer storages	1	-1	1	1	1	3
vertical space	2	1	0	1	1	5
adaptable furniture in meeting space	1	2	0	-1	-1	1

Explanation:

Table X. *Drawer Storage vs Space-Saving Home Office*

Maximize Utilization of Space	Stairs will take up more space than they will provide not allowing for the full utilization of space
Adaptable Furniture	Drawer storages contain tables/chairs with drawers that are harder to manufacture and could be heavy to lift, Ottoman seats are more seat specific that tends to smaller items for storage, items could take up more space if incorporated with a drawer
Minimize Cost	sleeve storage and drawer dividers are far less costly than installing stairs within a space or the cost of multiple ottomane seats
Durable and Robust	The table and chairs utilized are simpler and therefore more durable than

	Nesting Cabinets inside walls or Wall-Mounted Drop Leaf tables as they have fewer components to malfunction on.
Secure	Drawers can be locked up so as to keep all storage in drawers in safety. It is a more reliable way as a storage solution cause people cannot get access to these storage without the key. Especially in comparison to the simple storage under Ottoman seats.

Table X. *Vertical Space vs Space-Saving Home Office*

Maximize Utilization of Space	Stairs will take up more space than they will provide not allowing for the full utilization of space
Adaptable Furniture	Using vertical space will provide more room to walk around and use the floorspace to have more people in the room. As well as dividing each room into work and storage will help make sure each room is being used to its full potential
Minimize Cost	The cost of these two design solutions are similar since both involve buying furniture (shrinkable furniture vs. ottoman seats and wall mounted drop tables) which will result in equal cost.
Durable and Robust	Shrinkable furniture with storage is more durable and robust than Nesting Cabinets inside walls, Wall-Mounted Drop Leaf Table or complicated furniture utilized that could break easier.
Secure	Elevated storage units are equipped with lockers, which makes it much safer than the Space -Saving Home Office with very simple storage way like Ottoman-seats. Meanwhile, storage can also be hidden in shrinkable furniture to increase its security.

Table X. *Adaptable Furniture in Meeting Space vs Space-Saving Home Office*

Maximize Utilization of Space	Shrinkable furniture can help clubs adapt to their needs and what they need to use the space for.
Adaptable Furniture	Tables and chairs are all adaptable to store items and be used as furniture. Tables are able

	to store bigger items below while Ottoman seats may store the smaller, stairs for bigger storage maybe be too big of a constructed solution to store big items.
Minimize Cost	similar items with ottoman seats in both design solutions results in similar costs for both solutions
Durable and Robust	Foldable Tables/Desks, Ottoman seats (storage under the seat), Incorporating baskets and large nets on the ceiling are all furniture with lots of components that could break easily even compared to Nesting Cabinets inside walls and Wall-Mounted Drop Leaf Table. Therefore, this solution is less durable and robust.
Secure	The incorporating baskets and large nets on the ceiling does not have any protection thus storage in it can be easily taken away. Its protection is not that reliable in comparison to the hidden Ottoman seats storage.

**APPENDIX L: Measurements****Measurements Taken**

Smallest Room: 610

Dimensions: 111 inches x 83 inches

Largest Room: 505

Dimensions: 199 in x 173 in

6<sup>th</sup> Floor Hallway:

Length: 384 inches

Width: 31 inches

**Lockers**

Current size: 36 inches x 72 inches

- Additional Simulations for alternate designs

## Appendix M: Client Meeting Notes

Client Meeting 2: March 5, 2024

### Conversation about PR:

- 1) Problem Statement
  - sounds good to client
- 2) Physical Environment
  - rooms
  - storage on the 6<sup>th</sup> floor
- 3) Stakeholders
  - looks good
- 4) Functions
  - description of secondary functions
    - ↳ "safe" storage
    - physically safe
- 5) Objectives
  - looks good
- 6) Constraints
  - looks good

Creating a Google Form about  
what the club leaders want.

↳ Alyssa will send it out

### Measures of success

- clubs wanting to be here
- proper storage
- livelier community

### \*For Benchmarking\*

- UTSU



UNIVERSITY OF TORONTO  
FACULTY OF APPLIED SCIENCE & ENGINEERING

DATE	3.5	STUDENT NO.	
FULL NAME	MEIXI CHEN		
ASSIGNMENT	2nd Client meeting	COURSE	APS112

1. Go through PR Document with client.

↳ Checking the information

i) Problem Statement

- Good

ii) Stakeholders

- Good

iii) Functions

- The design must provide a better storage . . . .

↳ Add "Safe" factor.

iv) Objectives

- Good

v) Constraints

2. Question

- Asking for the Users' Survey for their ideas.

- Clubs conflict.

- Measure of success.

↳ Clubs want to keep the space longer

↳ Life Community change after solution (Vibe)

↳

- Benchmarking: UTSU /

- Presentation

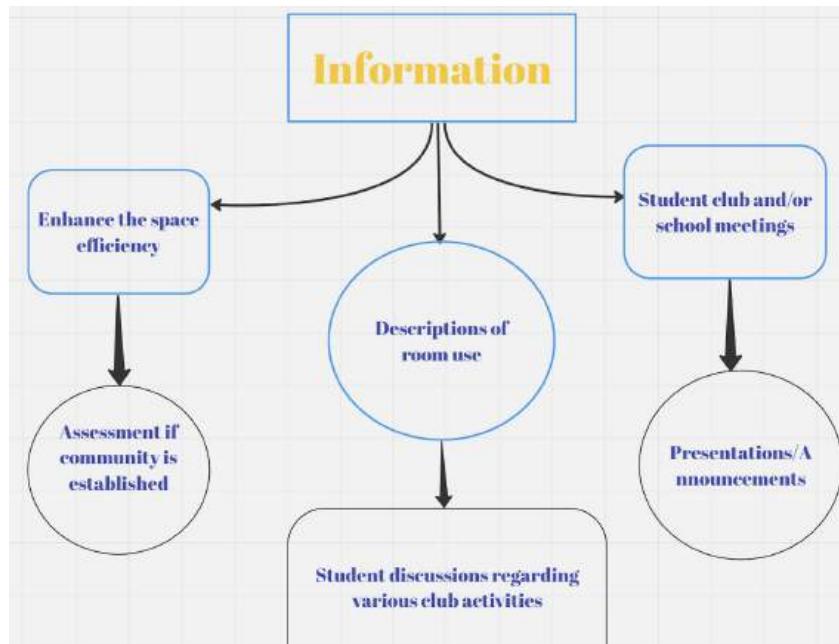
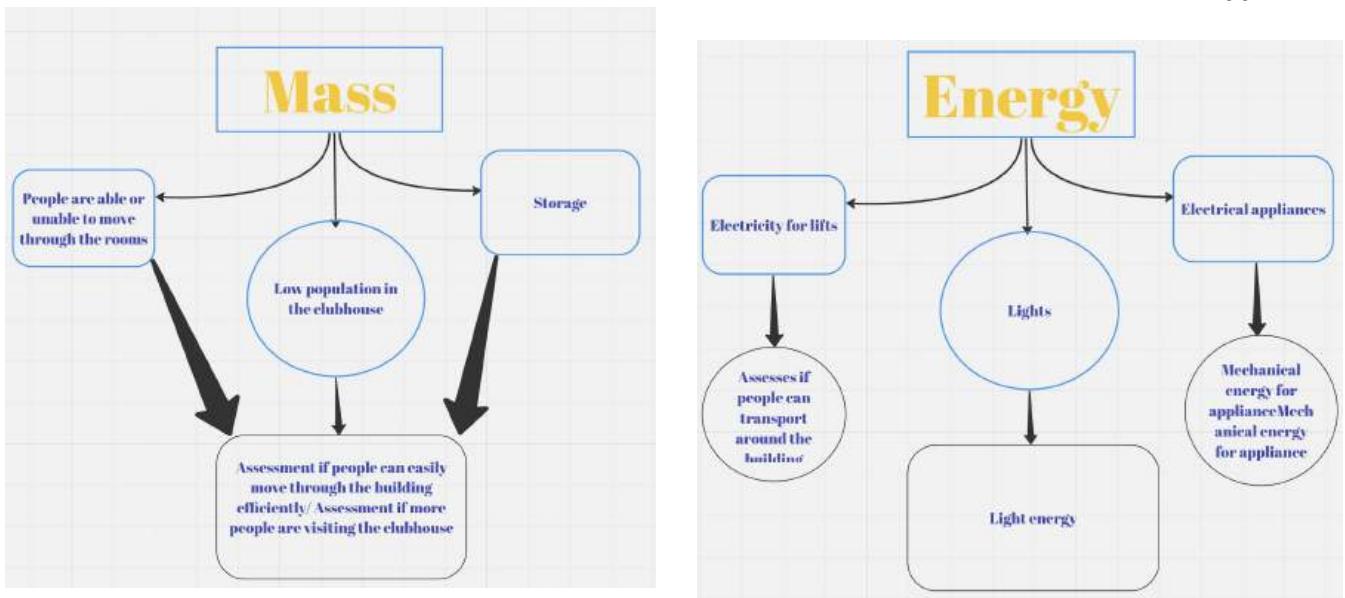
- Measurements

## Appendix N. Black Box Method: Functions

This section outlines the methods employed to derive the design functions. The "inputs" are put through a black box analysis of our design to observe the "outputs".

Table 13. *Black Box Method Analysis of the clubhouse*

Inputs		Outputs
Mass		Mass
<ul style="list-style-type: none"> <li>- People are able or unable to travel through the rooms in the building</li> <li>- Low population in the clubhouse</li> <li>- Storage</li> </ul>		<ul style="list-style-type: none"> <li>- Assessment if people can easily move through the rooms within the building efficiently</li> <li>- Assessment if more people are visiting the clubhouse (floors 4,5, and 6)</li> </ul>
Energy	→ Design →	Energy
<ul style="list-style-type: none"> <li>- Electricity for lifts</li> <li>- Lights</li> <li>- Electrical appliances.</li> </ul>		<ul style="list-style-type: none"> <li>- Assesses if people can transport around the building</li> <li>- Mechanical energy for appliances</li> <li>- Light energy</li> </ul>
Information		Information
<ul style="list-style-type: none"> <li>- Enhance the space efficiency within rooms on the 4th, 5th and 6th floors.</li> <li>- Descriptions of room use</li> <li>- Student club and/or school meetings</li> </ul>		<ul style="list-style-type: none"> <li>- Assessment if community is established</li> <li>- Student discussions regarding various club activities</li> <li>- Presentations</li> <li>- Announcements</li> </ul>



## Appendix O. Price Rational

Design 1: The average shrinkable bench costs \$82.28 [18] and will add up to \$575.96. Approximate sized cabinets cost \$490 [19] and will add up to \$4410. Wall-placed shelves add up to \$213[20]. Average office tables range from \$500-1000[21]

Design 2: Tables with drawers range from \$110-\$1332 [23] which total to \$220-\$2664. Small

Ottoman seats cost \$82 [24] that total to \$492. Approximate sized cabinets cost \$490 [19] that total to \$2450

Design 3: Small Ottoman seats cost \$82 [24] that total to \$984. Extendable tables with storage have an average price of \$420[25] which total to \$840. Average baskets that can be hung cost \$20 [26] which total \$360.

## **APPENDIX P. Client survey questions**

- Over the last 4 weeks did more members utilize the space?
- Were club members happier/more keen on coming to meetings?
- Did the usage of the clubroom increase? If so, by how much (ratio of people coming before vs after)?
- How is the overall experience utilizing the club rooms?
- How much longer is your club planning on utilizing the space? (i.e. one more year)
- Compared to before the redesign, would you consider using the space more in the long run or short run?
- What aspects of the design made it easier to navigate your room?
- Did certain aspects of the design bring in more members to your club?

## Attribution Table

Tutorial #: 0114	Team #: 095
Assignment: Conceptual Design Specifications	Date: 25/03/2024

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Executive Summary	MR, WD, ET, FP			MR, WD, ET	ET, MR, FP	ET
Introduction	MR, ET, FP			MR, ET, FP	ET, MR, FP,	
Service Environment	MR, ET, FP		MR, ET	MR, ET, FP	ET, MR, FP	MR
Stakeholders	MR, FP	ET	MR, ET	MR, ET,FP	ET, MR, FP	MR
Detailed Requirements	MR, ET, FP		ET	MR, ET,FP	ET, MR, FP	
Idea Generation	ET, MR, FP		WD	MR,FP	WD, ET, MR, FP	ET
Idea Selection	MR, FP	ET		MR, ET, FP	WD, ET, MR, FP	MR, ET
Alternative Design Solutions	RS2, MR		ET	ET, MR,FP	WD, MR, ET	ET
Proposed Conceptual Design	ET, MR, FP	WD	ET	WD, MR, ET,FP	WD, ET, MR, FP	
Measures of Success	ET, FP	WD,MR, RS1		MR, ET, RS1,FP	WD, ET, MR, FP	
Conclusion	ET, FP	ET	ET	ET, MR,FP	WD, ET, MR, FP	WD MR ET
Appendix A			WD, MR, ET, FP		MR	WD, MR, ET, FP
Appendix B					WD, MR, ET, FP	
Appendix C			WD, MR, ET, FP		WD, MR, ET, FP	
Appendix D	WD, MR, ET, FP			WD, MR, ET, FP	WD, MR, ET, FP	
Appendix E	WD, MR, ET, FP	WD, MR, ET, FP				
Appendix F	WD, MR,	WD, MR, ET, FP				

	ET, FP					
Appendix G	WD, MR, ET, FP	WD, MR, ET, FP				
Appendix H	WD, MR, ET, FP			WD, MR, ET, FP	WD, MR, ET, FP	
Appendix I				WD, MR, ET, FP		
Appendix J	MR, ET, FP	MR, ET, FP	WD, MR, ET, FP	MR, ET, FP	MR, ET, FP	WD, MR, ET, FP
Appendix K	WD, MR, ET, FP	WD, MR, ET, FP	WD, MR, ET, FP	WD, MR, ET, FP	WD, MR, ET, FP	
Appendix L	WD, MR, ET, FP			WD, MR, ET, FP	WD, MR, ET, FP	
Appendix M	WD, MR, ET, FP				WD, MR, ET, FP	WD, MR, ET, FP
Appendix N		WD, MR, ET, FP		WD, MR, ET, FP	MR	
Appendix O					WD, MR, ET, FP	
Appendix P			WD, MR, ET, FP			WD, MR, ET, FP
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**RS1- research to support measures of success**

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