

University of British Columbia

Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

# Laboratory Equipment Reuse Roadmap

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Prepared for:

Course Code: CHBE 573

University of British Columbia

Date: 25 April 2021

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## EXECUTIVE SUMMARY

UBC Sustainability has always played an important role in accelerating UBC's Green initiatives. SEEDS (Social Ecological Economic Development Studies) program is an experiential learning platform coordinating students, staff, faculty, and industries across Canada and worldwide, focussing on social, ecological, and environmental problems. As a part of SEEDS initiative and collaboration with CHBE 573 Environmental engineering and Sustainability Leadership course, the "Laboratory Equipment reuse road map" project is presented.

An estimated 3200 tonnes of solid waste is sent to landfill annually and a significant portion of it comprises of waste from laboratories. The high-level motivation of this project is to reduce the solid waste going into landfills and upcycle them into the laboratory cycle. In 2019, drawing inspiration from similar motives to reduce solids going into the landfills, the Office equipment reuse program was launched and it had significant contributions towards CAP 2020.

This "Laboratory Equipment reuse road map" project similarly focuses on reusing Surplus/Unused Lab equipment. This report summarises the flow and key findings of the project focusing on the background, scope of the study, the methodology used, case studies, results, and finally our main conclusion. The team carefully curated a survey focusing on the needs of the client and stakeholders compliance by asking questions about current disposal practices of surplus lab equipment, acceptance and expectations of the new "Reuse-it!" program for stakeholders, and by identifying potential barriers and challenges for buying and selling used equipment at UBC.

To understand the dynamics of the logistics and operations we looked at two universities where current reuse practices exist. The case studies conducted at the University of Michigan and Columbia University yielded insights into the adaptation of an equipment reuse program inside an institution. Many recommendations and alternative conclusions were drawn and they are briefly described in this report. This report also discusses strategies for continuous stakeholder engagement inside UBC as a part of its recommendations.

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## 1. BACKGROUND

In 2011, UBC achieved a “Gold” rating in STARS (Sustainability Tracking Assessment & Rating System), which is an international framework for Universities to measure their sustainability performance [1]. This success to date is highly driven by UBC's Zero Waste Action Plan. This action plan targeted UBC towards increasing its overall diversion rate (i.e. percentage of waste that is recycled or composted) to 70% by 2016 and to 80% by 2020 [1]. The Zero Waste Action Plan is adapting operational waste disposal over landfill/incineration steadily despite the campus' growth in size and population, considerable success is observed in the area of active waste management.

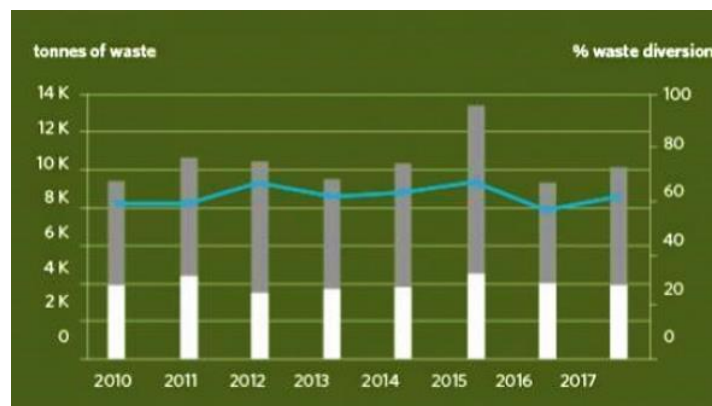


Figure 1: Materials & waste trends for the UBC Vancouver campus, 2018 [1]

Based on Figure 1, it is reported that UBC's Vancouver campus diverted 61% of its overall operational and construction waste from the landfill in 2017, lagging behind the diversion target which is 70% by 2016 [1]. In terms of construction waste, 100% of construction waste from institutional buildings diverted from the landfill by 2035, as targeted in our UBC Green Building Action Plan[2].

The “Laboratory equipment reuse road map” project, which aims to reduce the environmental impact of laboratory activities by incorporating sustainability practices such as engaging stakeholders to buy and sell surplus laboratory equipment, instead of sending it to the landfill or being left unused. The official process for reusing equipment and supplies in UBC is based on Policy UP3 (Previously Policy 108), which is called "Disposal of Surplus Equipment and Materials" [6]. The policy ensures that the recycling and reusing of surplus equipment is accessible to UBC internally before selling to other Universities and other external stakeholders.

The “Reuse-it!” UBC program launched a website in 2011 that acted as a “virtual warehouse” to facilitate buying and selling of used office supplies and equipment on campus [7]. The “Reuse-it!” program replaced UBC's SERF (Surplus Equipment Reuse Facility) that was used from 1970 to 2006. SERF offered a store-front location for UBC students, staff, and faculty to purchase and drop off reusable items [7]. Due to logistical constraints, SERF closed its operations in 2006, and the program continued its operations on campus through word of mouth. In 2019, “Reuse-it!” UBC had nearly 2000 visits per month, while 63% of success rate was reported for the year on the selling products listed on this platform [7]. Additionally, there were 479 new registrations, in which 50% came from referrals by a colleague or co-worker [7].

Upon further research, we discovered existing platforms for equipment reuse/selling operating internally within various UBC departments (Eg-LSI re-use) [8]. The life sciences institute has an internal system for reusing different types of equipment. They have a page for posting used, LSI-related, lab equipment that is available for free or at reduced prices [8]. In 2019, the "Office Furniture Reuse at UBC" a SEEDS study was deployed by UBC sustainability, which focused on the broader vision for UBC to become an institution that produces net-zero waste by reducing office furniture (or related materials) from being sent to landfills. This study demonstrated a large potential for cost savings of over \$600,000 through a dedicated office furniture reuse program. Our study's high-level objective draws motivation from this 2019 project, by focusing on determining interest and concerns amongst UBC stakeholders in increasing the reuse of surplus laboratory equipment through participating in the "Reuse-it!" program.

## 2. PURPOSE

The reason for equipment surpluses varies to a great degree. It might be due to frequent shifts in focus areas requiring new technologies each time a research topic emerges, resulting in the current equipment being outdated in keeping on par with research needs. Additionally, when one researcher finishes their study, the equipment could become obsolete for others to use, and there may be space restrictions inside the lab. To eliminate the equipment surpluses while simultaneously reducing the burden on the budget to procure new equipment as part of the SEEDS sustainability initiative, this Laboratory equipment reuse road map project is undertaken.

This project's scope includes identifying a need for creating an inventory of UBC's surplus and unused laboratory equipment which is eligible for reuse, internally based on equipment specifications and quantities available. A medium to facilitate the reuse of laboratory equipment is recommended by garnering interests and preferences from various stakeholders to buy and sell used laboratory equipment on and off-campus. The recommended process highly relies on stakeholder input in potential challenges associated with the lab equipment's logistics to transfer from one place to another.

Overall, this project aims to establish a better understanding of UBC surplus laboratory equipment that could be reused, document current surplus handling and disposal practices, and evaluate the potential for integration of this waste stream into a wider campus Reuse Program. In addition, this project comprehends strategies that promote continuous engagement with the stakeholders in order to ensure the perpetuation of this program.

### 3. METHODOLOGY

#### 3.1 OVERALL PROCESS

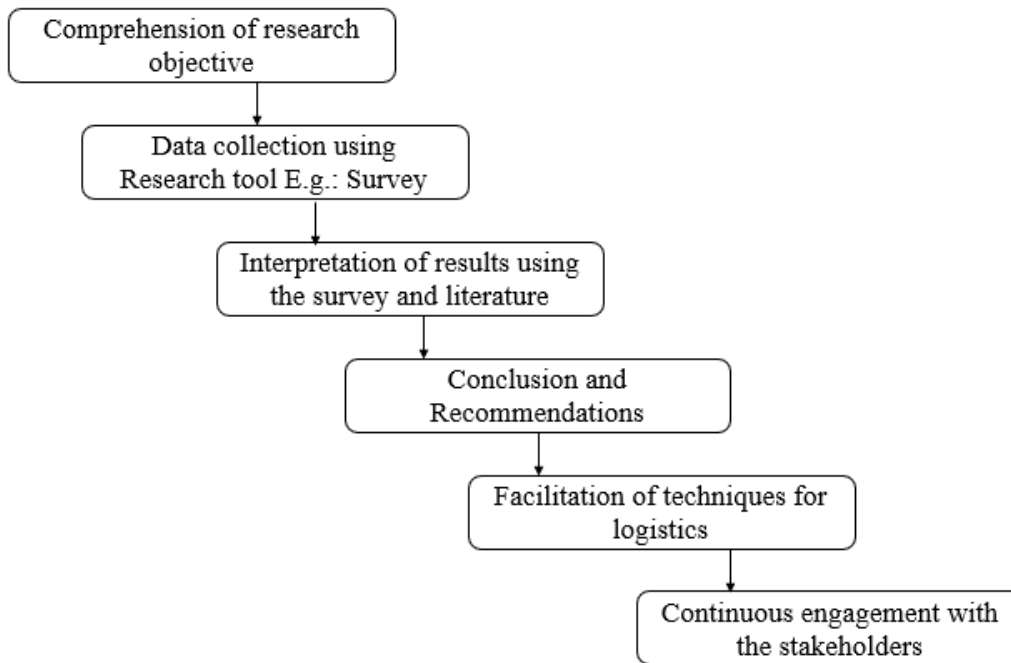


Figure 2 : Flow of the project

The experiential learning methods discussed in class were incorporated into this SEEDS project, specifically design thinking, system mapping, and adaptive leadership. More generally, the project followed the model of Regenerative Design, in which our system includes team members, clients, and stakeholders. The clients include the SEEDS Coordinator & Project Clients. The stakeholders include lab managers, Person of Interest (PI) and administrators.

First, we identified the individual strengths of team members and delegated responsibilities accordingly to meet the demands of our project. Based on the concept of design thinking, we defined the problem statement after having discussion with the clients and identified the leverage points to carry out our objectives. We then completed project system mapping to help us solidify the problem statement, generated hypotheses as to why the problem exists, and then we defined the project scope.

We created our survey (the research tool used in our project for data collection & interpretation of results) in consultation with our clients to collect pertinent information from said stakeholders. Finally, we identified and contacted potential stakeholders by searching through faculty lists of several UBC departments that conduct laboratory research to then implement our surveys by contacting said stakeholders through email.

The core adaptive challenge we faced in this project was during the survey design process. The client had expected us to gather more information about the general surplus/unused equipment handling &

disposal practices whereas we restricted our focus initially onto the current surplus equipment handling and disposal practices. Therefore, our survey required several iterations before the final publication, making it a part of testing and client feedback loop, which in turn is a part of our design thinking approach.

We designed the survey in such a way that it includes the policy and innovation scope, by identifying possible future scenarios for restructuring the project so that it caters to all client needs.

We spanned the boundaries from fulfilling client expectations to meeting the needs of both buyers and sellers by drafting the survey questions in which we had to “zoom out” and prepare the survey questions by carefully listening to clients’ needs with a non biased point of view and then “zoom in” while preparing the questions of survey, to include the stakeholder’s perspectives as well which focuses upon the challenges & barriers of selling and buying. Once again we had to “zoom out” for interpretation of responses from stakeholders while drawing possible solutions to accommodate sellers, buyers as well as client’s needs.

Finally, during the final stage of the project, we applied the principles of emergence such as cooperative work and collective sustainability. An interesting challenge during the project was choosing the “lucky draw” winners amongst survey respondents. There was an uncertainty in evaluating which survey respondents would win the “lucky draw” prizes, since randomizing the event would prove to be a challenge and essentially unfair, if drawing the attention of certain stakeholders to complete the survey may have resulted in poor survey responses. We wanted to incentivize full participation in completing the survey, and so we randomized the prize winners amongst individuals who completed it fully. Our team, in cooperation with our clients, chose to randomize the prize winners based on the quality of survey responses. Hence, we learned this principle of emergence through this project where we need to value both the process and outcome while designing a process.

### 3.2 SURVEY COMPOSITION AND DISTRIBUTION STRATEGIES

The target audience of the survey (the stakeholders) was identified by drafting a list of several UBC STEM (Science, Technology, Engineering, Mathematics) departmental contacts who use laboratory equipment and tools. Then drafting of the initial survey questions was done based on the needs and expectations of the client. Followed by that, few iterations were carried out and the survey was modified as per the client’s feedback. Finally, the survey was published using the UBC Qualtrics tool and the stakeholder responses were finalized and documented after a three-week response time.

As mentioned, a “lucky prize draw” was offered, as a part of the survey incentive, to all participants who take part in the survey with a chance to win gift cards worth up to \$50. Furthermore, we requested the identified stakeholders for the responses from their colleagues and acquaintances as well, who deal with equipment and tools, including non-laboratory equipment.

### 3.3 PROJECT CHALLENGES

The survey response rate was a major challenge faced during the project. The number of survey respondents was too low with the initial stakeholder list supplied by the client. To enhance the response rate, we contacted several UBC STEM faculties through email, which was obtained from their website, in addition to the client’s stakeholder list (thereby increasing the number of surveys to be distributed to 150). However, out of 150 recipients, the number of survey respondents was 20, a 13% response rate.



In the wake of Covid-19, approaching the stakeholders physically for the survey and to follow up with them was not possible due to safety protocols. Otherwise, collection of information not only about equipment handling and disposal practices but also about their ideas & effective strategies could have been possible. However, we heavily relied upon email communication, which restricted participant responses only to survey questions.

Framing the questions of the survey also proved to be a challenge, requiring iterations around 5-6 times as per the client's expectations, which in turn required alteration in the timeframe proposed initially in the Gann Chart from a 2-week response time to 3-week response time for stakeholders.

## 4. RESULTS AND DISCUSSION

The survey aimed to accomplish three things: Identify current practices on surplus lab equipment at UBC; Determine potential acceptance and expectations of the "Reuse-it!" program; and Current buying and selling methods of used laboratory equipment.

### 4.1 CURRENT PRACTICES OF SURPLUS LAB EQUIPMENT

According to the administered survey, 80% of the total respondents at some point donated equipment to another UBC group in the past while 55% of respondents said they are more likely to place unused equipment in storage or leave it unused in the lab. As demonstrated by Fig.3, Another 25% donated equipment to an external research group that is not part of UBC, and 10% sold the equipment to an external research group. 20% of respondents sold to another UBC group, while 10% exchanged equipment for other UBC equipment. 40% of the "Other" ways for disposal included Recycling and trashing them. It is interesting to note that in Fig 3 35% of the respondents said they have neer exchanged lab equipment. But, there is an exchange of equipment occurring between laboratories, likely due to collaborations that involve multiple research groups. Additionally, equipment being sold to other UBC researchers on campus seems to be quite low among respondents at 20%, demonstrating a potential for improvement with the "Reuse-it!" program. There is potential here for an increase in the use of the "Reuse-it!" program and will be discussed in the recommendations section of this report.

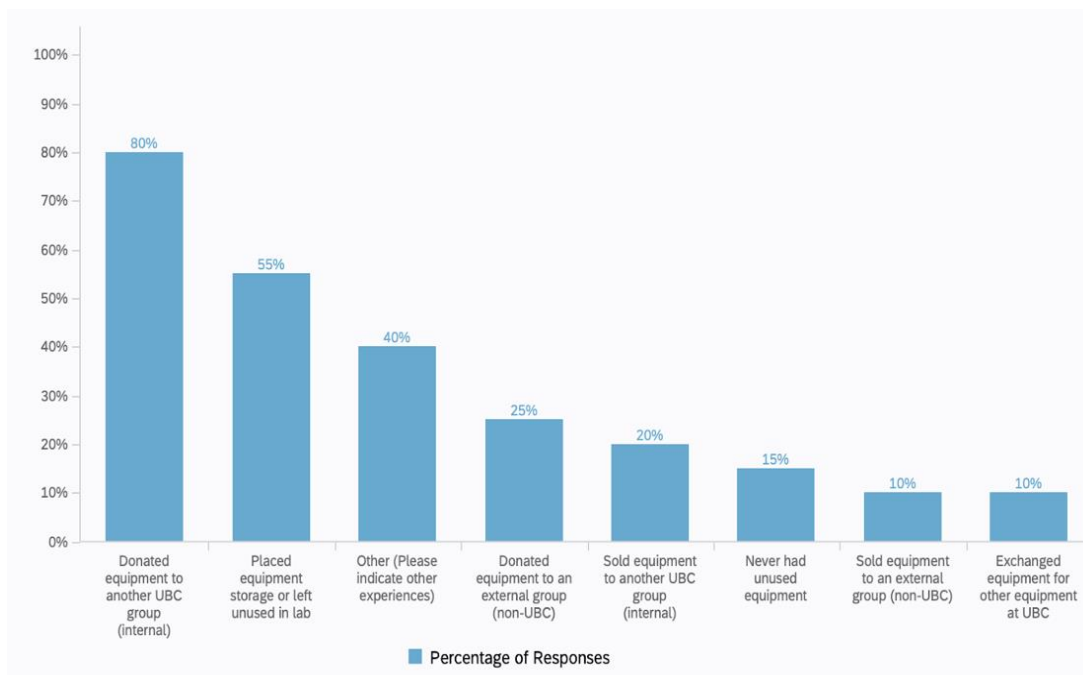


Figure 3: Data on current disposal and storage practices

Figure 4 represents the mode of communication for individuals who report selling equipment. 50% of survey respondents communicated with buyers by word of mouth while 30% sent out an email to potential recipients. Only 20% of survey respondents reported using the “Reuse-it!” program, while another 35% have never exchanged equipment with other researchers. This data demonstrates that there is potential to increase the usage of sellers who use “Reuse-it!” as their primary method of selling equipment to a larger audience of buyers. There is potential here for an increase in the use of the “Reuse-it!” program and will be discussed in the recommendations section of this report.

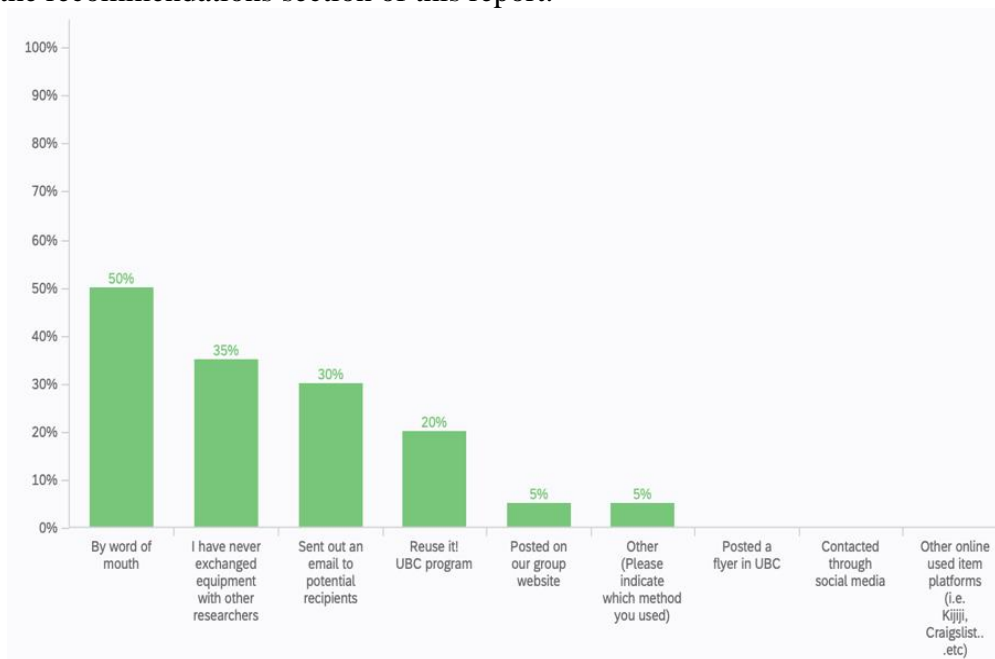


Figure 4 : Mode of communication between the current buyers and sellers (Selling)

Figure 5 represents the mode of communication that survey respondents reported using when buying equipment from other researchers. 71% reported buying equipment through word of mouth while 65% reported that an email was sent to them regarding the sale of a piece of equipment. Only 24% of survey respondents reported using the “Reuse-it!” program to buy equipment, which is close to the number of survey respondents who report using the “Reuse-it!” program to sell equipment (20%).

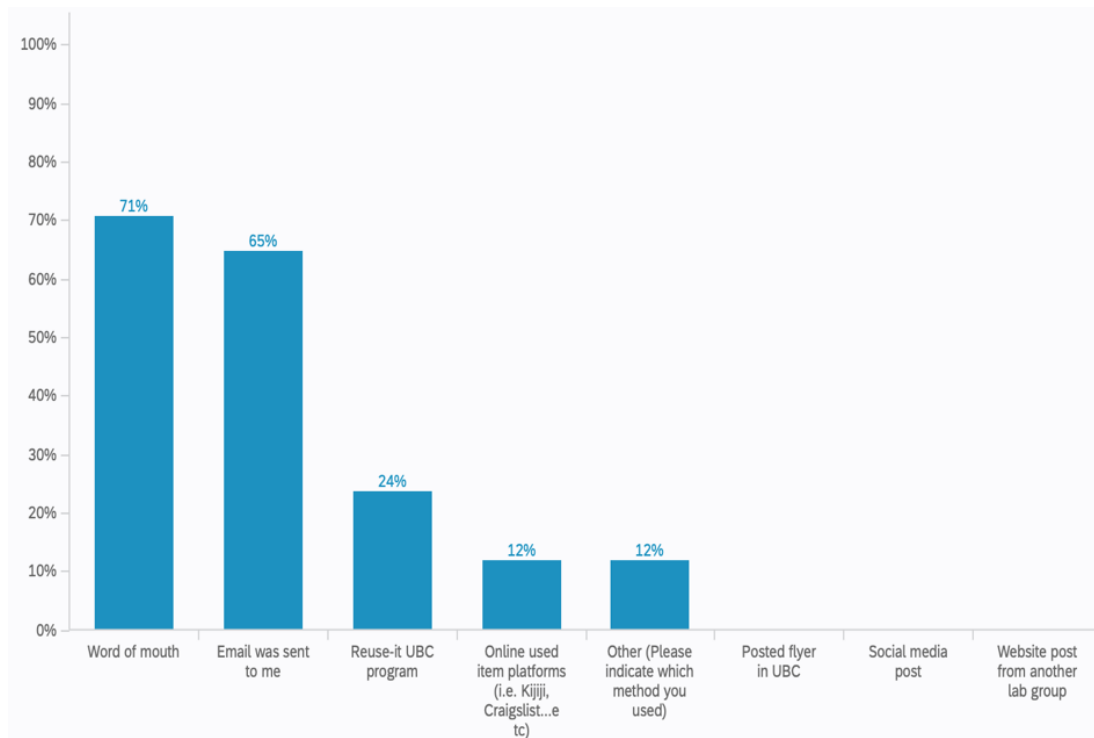


Figure 5: Mode of communication between the current buyers and sellers (Buying)

45% of sellers report that uncertainty of payment transactions regarding the exchange of equipment through the “Reuse-it!” program is the main source of concern acting as a constraint as shown in Figure 6. Another 35% report the possibility of not having relevant details about the equipment and another 30% say the difficulty in coordinating logistics for the exchange of equipment as the main concern. Solutions to these issues will be presented in the recommendations section of this report.

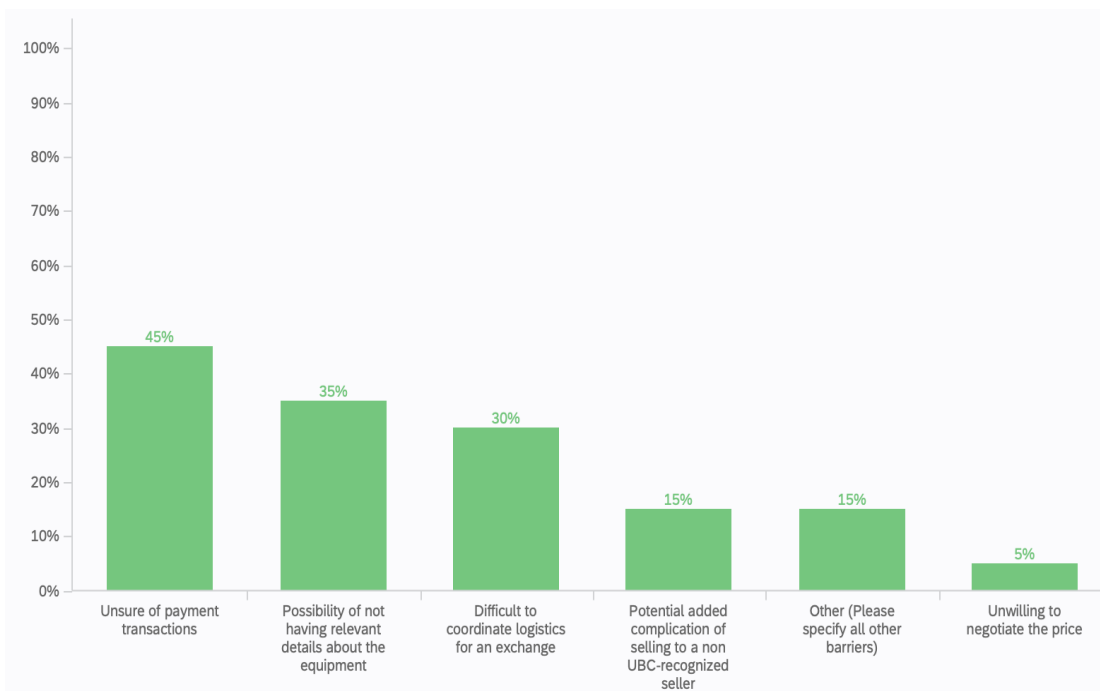


Figure 6 : Possible constraints faced during selling reused equipment

For buyers, the main source of concern at 75% is the uncertainty surrounding the quality of the equipment they are to buy from sellers. Another 70% say that the difficulty in finding items that meet exact needs is a difficulty, in addition to another 50% saying they would need to know the history of usage for the equipment before purchasing it. Additionally, 25% say that they are unsure of the payment transactions and 25% are concerned about the difficulty surrounding the coordination and logistics of an exchange of equipment. Solutions to these issues will be presented in the recommendations section of this report.

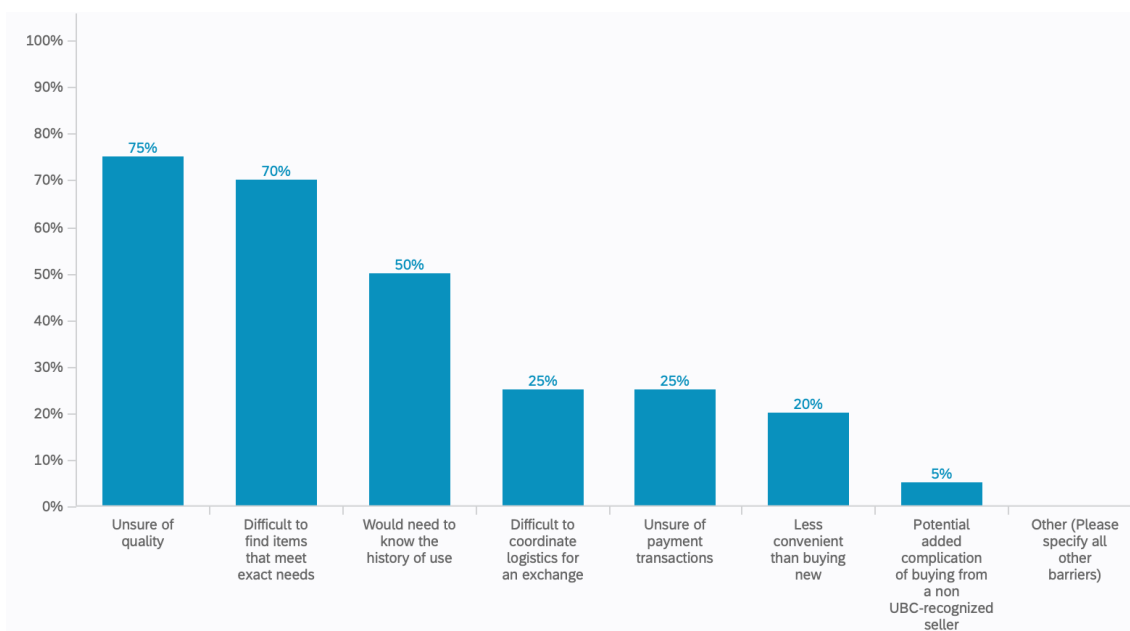


Figure 7 : Possible constraints faced during buying reused equipment

## 4.2 ACCEPTANCE AND EXPECTATIONS OF SURPLUS LAB EQUIPMENT REUSE PROGRAM AT UBC

The results of the survey indicate that there is a 95% interest among the respondents in favor of the lab equipment “Reuse-it!” program at UBC based on Figure 8. This indicates that the program is closer to success when there is proper channeling of buying and selling.

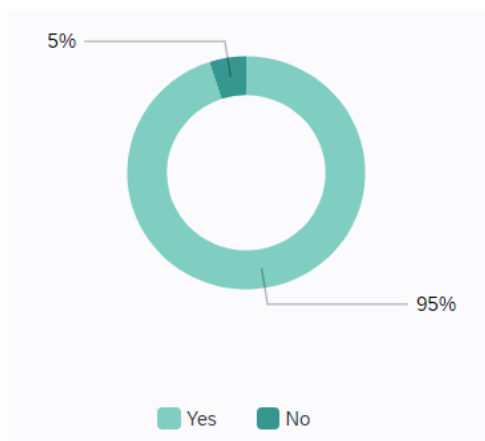


Figure 8: Acceptance level on surplus lab equipment reuse program

The “Reuse-it!” program is welcome provided certain conditions are satisfied, the expectations of the stakeholders from the system are shown in Figure 9. From the data collected it is concluded that all the respondents (100%) wanted to maintain an advertising platform operating internally within UBC. Also, 84% of them believed the system should facilitate a medium to connect the buyers and sellers in and around UBC. Additionally, 63% wanted a payment platform through web service along with advertising and a few of them responded that providing storage spaces (warehouses, etc) would be beneficial.

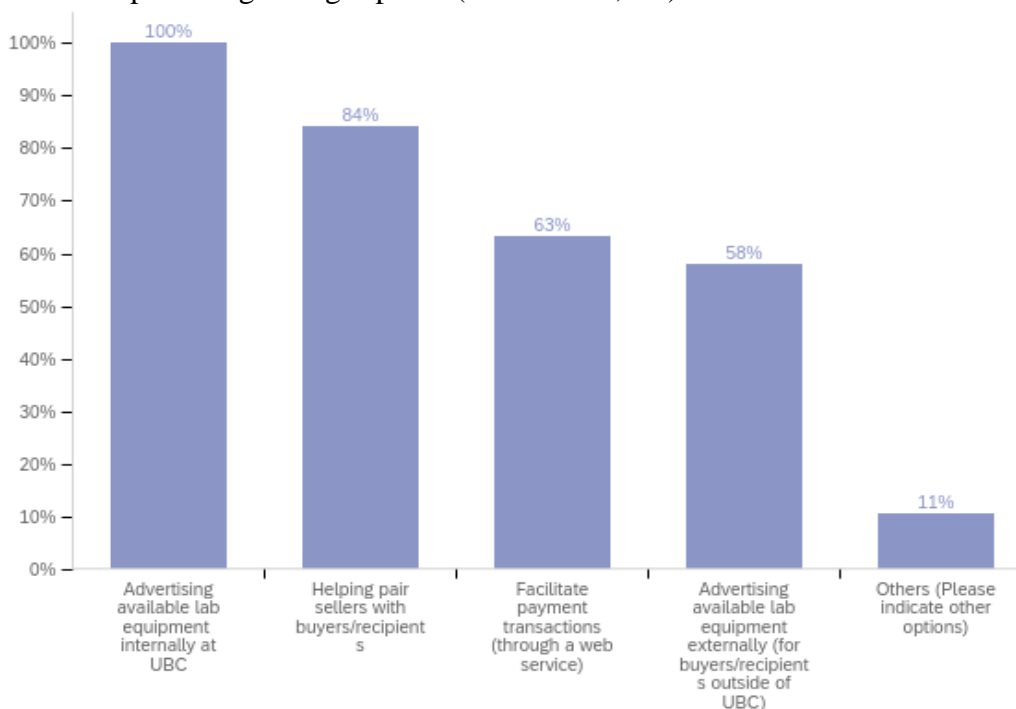


Figure 9 : Expectations from the reuse program

It was speculated that if the commissioned system would be an online platform having an internal payment platform, there would be a small convenience fee collected by the web agency providing the service. We tested the willingness of the stakeholders to pay a transaction fee of 5-10% and the results are very poignant, 63% of the respondents agreed to pay the proposed amount while 11% said they would not, 21% of the total preferred coordinating among themselves outside the platform. This brings a conclusion that, if facilitated, the transaction fee would not have a detrimental effect on the operations but may cause around a 30% reduction in the users.

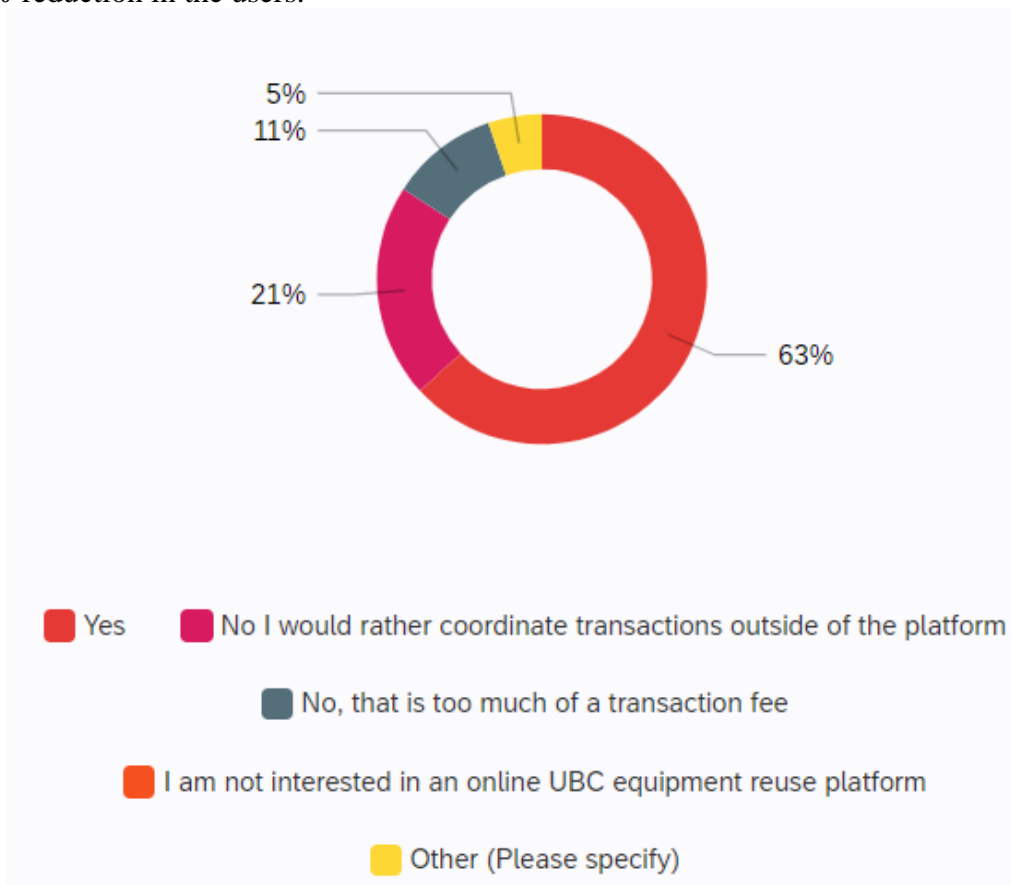


Figure 10 : Willingness to pay a convenience fee and its percentage if willing

The survey also targeted the preferred mode of transportation of lab equipment in and around UBC. Even though the logistics are highly dependent on the size and specifications of the equipment in question, a general perspective suggested that 38% of the total, preferred self-pickup in and around UBC and another 33% said it depended on the type of equipment. 21% felt the recipient or the buyer must coordinate the pickup. It is noteworthy that 0% of the respondents said they were not interested in an online equipment reuse platform, it points out there is potential and a great acceptance of an online platform to facilitate buying and selling of used equipment in UBC.

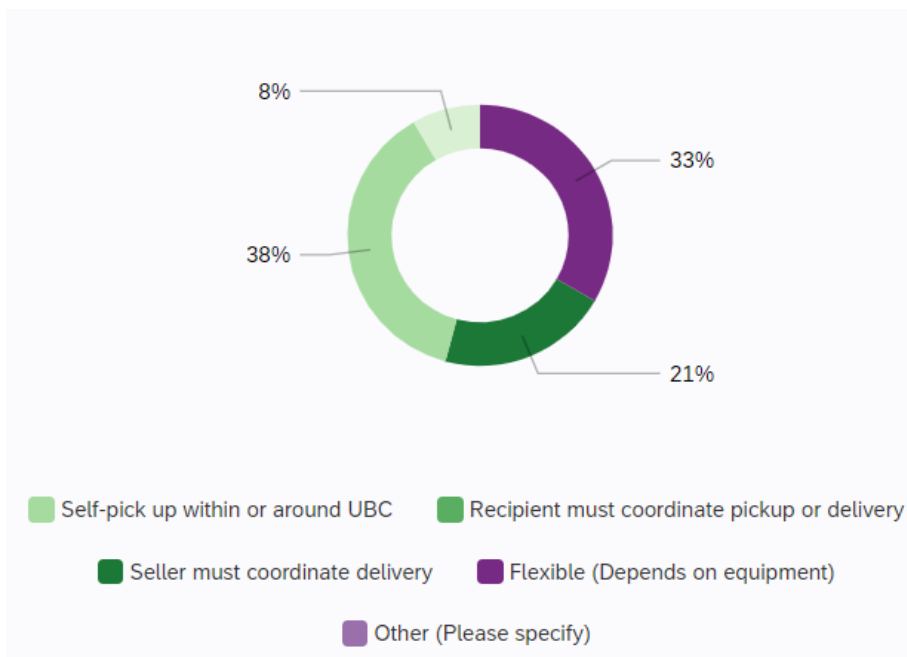


Figure 11 : Data on the preferred mode of delivery

### 4.3 DATABASE ON BUYING AND SELLING OF REUSE LAB EQUIPMENT

65% of all the respondents’ labs at UBC have a current hold of unused/surplus lab equipment in their storage. The lab in charge is aware of this plight and 95% are willing to make efforts to recycle the resource into a circular economy. The survey also aimed at collecting data on the current availability of various types and quality of unused/surplus lab equipment at UBC. This data is collected over a timeframe of three weeks in the month of March 2021. This is a representative fraction of the total supply at UBC and not a complete demand over the entire year. Results consisting of a sample space of equipment are listed below in Table 1. This table shows the current availability of unused/surplus equipment in UBC.

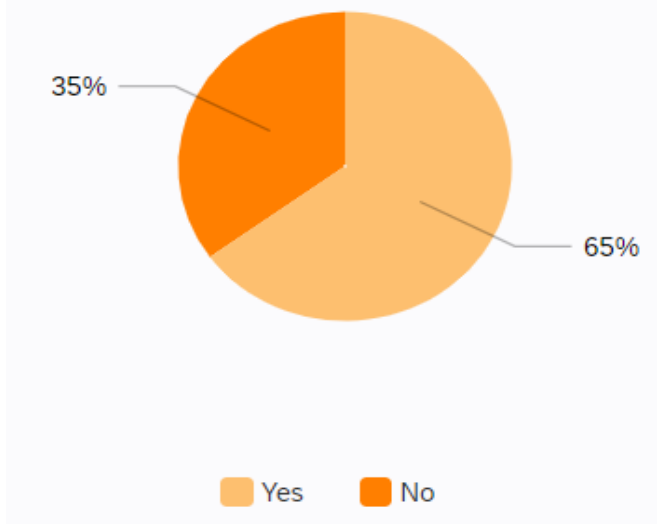


Figure 12 : Data on availability of surplus lab equipment

Table 1 : Amount and type of equipment available for selling/donating

<b>S.No</b>	<b>Types of equipment</b>	<b>Relative Supply (%)</b>	<b>In-hand Equipment in excess</b>
1.	Oven	7%	0
2.	Scale/Balance	8%	0
3.	Refrigerator/Freezer	10%	0
4.	Centrifuge	11%	1
5.	Vortexer	9%	3
6.	Sonicator/Homogenizer/Blender	9%	0
7.	Hot plate/Stirring plate	11%	8
8.	pH meter	7%	0
9.	Microscope	8%	6
10.	Spectrophotometer	7%	1
11.	Others	4%	9

Targeted data collection on the need and demand of used equipment in UBC was done, keeping the sample space like the supply. The relative demand of various equipment is tabulated below in Table 2.

Table 2 : Relative demand of used equipment

<b>S.No</b>	<b>Types of equipment</b>	<b>Relative demand (%)</b>	<b>In-hand Equipment in excess</b>
1	Refrigerator/Freezer	10%	15



2	Oven	7%	11
3	Scale/Balance	8%	12
4	Centrifuge	11%	16
5	Vortexer	9%	14
6	Sonicator/Homogenizer/Blender	9%	14
7	Hot plate/Stirring plate	11%	16
8	pH meter	7%	10
9	Microscope	8%	12
10	Spectrophotometer	7%	10
11	Glassware	9%	13
12	Others	4%	6

## 5. RECOMMENDATIONS

As mentioned, the “Re-Use it!” UBC program allows UBC employees at the Point Grey campus to find and exchange low-value items of \$1000 or less between UBC departments using the program's online virtual warehouse. For the “Reuse-it!” program to become a hallmark of sustainability on campus as it transitions to facilitating the trade of expensive laboratory equipment, several modifications must be made. According to the data retrieved from our distributed survey, such modifications to the “Reuse-it!” program including increasing “program accessibility and awareness, simplifying transaction methods, ensuring equipment reliability, and improving logistics and coordination processes. The following sections describe each of these recommendations for improvements in detail.

## 5.1 PROGRAM ACCESSIBILITY &amp; AWARENESS

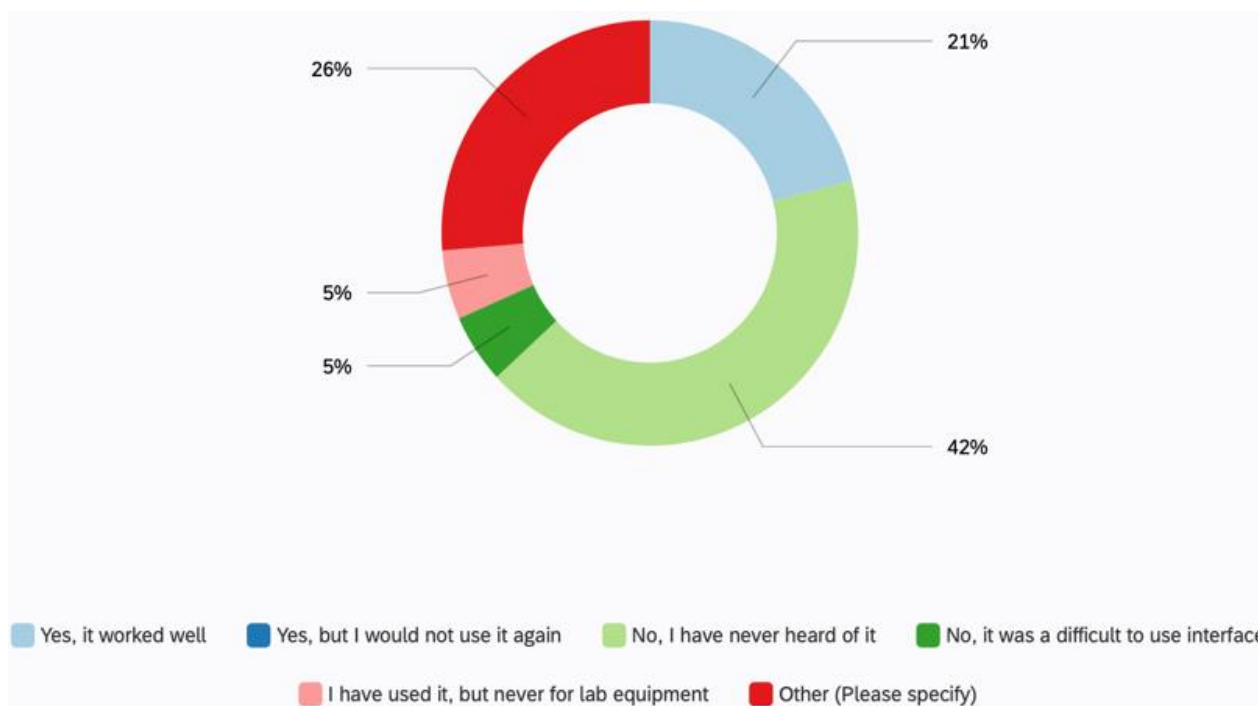


Figure 13 : Survey Data on Awareness about “Reuse it!” program

Figure 13 contains notable statistics that are telling of the program's effectiveness. 21% of survey respondents have used the “Reuse-it!” program and thought it worked well and 5% of survey respondents thought the “Reuse-it!” program interface was difficult to use. Considering the current program facilitates the trade of basic office supplies and furniture, one might expect that the difficulty of the current interface would increase as transactions of expensive laboratory equipment becomes more prevalent, potentially creating issues in processing larger purchases and distributing those pieces of equipment from the seller to buyer. Potential solutions to these difficulties will be discussed in later sections (simplifying transaction processes, improving logistics and coordination), as this section will focus primarily on increasing the accessibility and awareness of the program, which may have a positive impact on the percentage of individuals who think that the program works well. The collected data also tells us that 42% of survey respondents have never heard of the “Reuse-it!” program, indicating there is great potential for increasing the number of individuals who use it. The program itself must be easily accessible and broadcasted widely to increase stakeholder awareness and interest. Additionally, certain elements of the program must be made public to attract program attention, and potential buyers and sellers who are not faculty members, such as laboratory workers or graduate students, must be eligible to use the “Reuse-it!” program. These recommendations will be discussed in the following paragraphs.

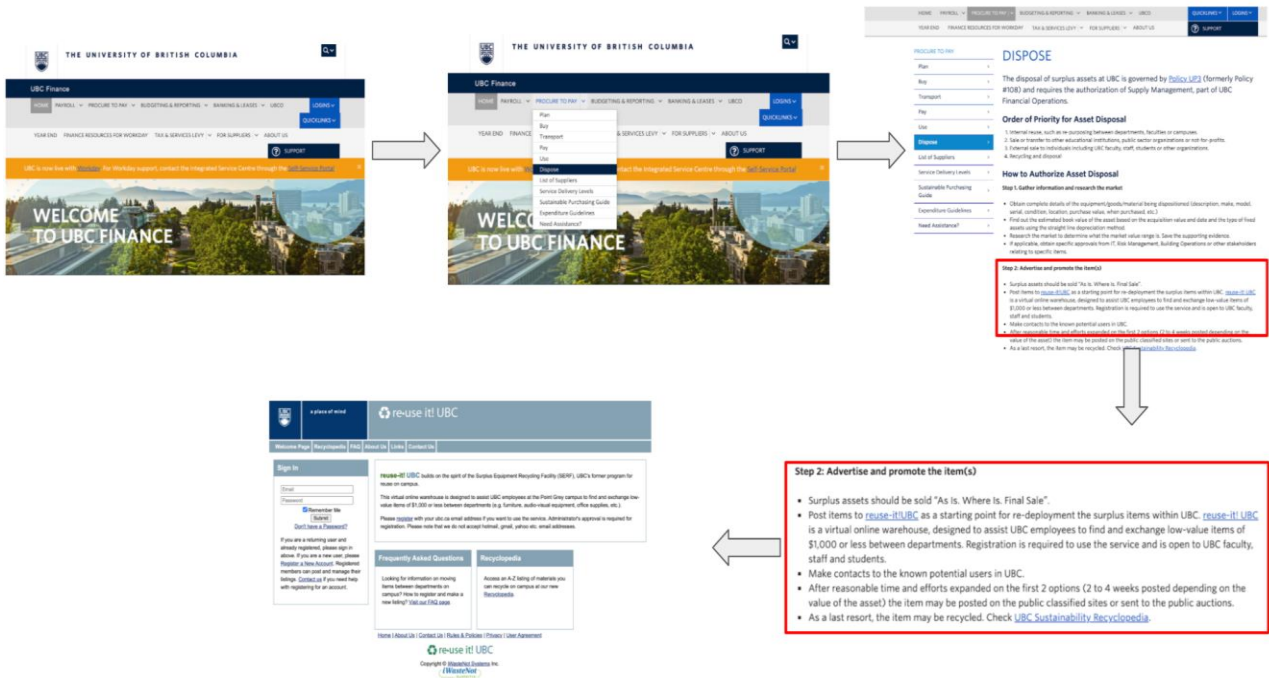


Figure 14 : Accessing “Reuse-it!” from the UBC Finance website

There are three different ways to find the “Re-use it!” program if an individual was not already aware of it. The first is through the UBC Finance website as seen in Figure 14. First, they must click “procure to pay” and then click “dispose”. This is typically the option an individual will choose if they are interested in getting rid of larger items in their laboratory, which are usually eligible to be sold through “Reuse-it!”. After clicking dispose, they must sign in to the UBC Finance website with their Campus Wide Login to access the next page that includes several disposal options, in addition to instructions on how to use “Reuse-it!”, as seen in Figure 14 under “Step 2”. When clicking on the “Reuse-it!” hyperlink, the website then appears as shown. After making it to the “Reuse-it!” website, an account must be created before the individual is able to see what items are for sale and how to sell their own belongings. After creating an account, the individual will then have gained access to buying and selling privileges of the “Reuse-it!” website.

There are several problems with this process of discovering and gaining access to the “Reuse-it!” program. The first is that the program is not directly advertised as a stand-alone option under the “Procure to Pay” tab in Figure 14 for buying and selling used office supplies and furniture. If the program was listed as a stand-alone option under the “Procure to Pay” tab, there would likely be an increase in the website's traffic, considering it would be easily visible and accessible to those visiting the UBC Finance website. In addition to creating a “Reuse-it!” option under the “Procure to Pay” tab, a banner for the website could also be created and displayed on the UBC finance website as part of an advertising scheme to catch the attention of those visiting the website.

Additionally, individuals who are interested in buying used items will not be exposed to the program by clicking on the “Buy” tab under “Procure to Pay” in Figure 14. An option for the “Reuse-it!” program could also be presented here as a way to further integrate the program into the UBC Finance website.

Furthermore, when clicking on the “Dispose” option under “Procure to Pay” in Figure 14, the individual must then locate the “Reuse-it!” option under the heading “Step 2”, and be inclined to click on

the hyperlink, which then redirects them to the “Reuse-it!” website. Once they arrive at the website, they must then create an account separate from their UBC campus-wide login (CWL) to be able to see any of the products listed for sale. The first issue with this is that the hyperlink is quite small and may not catch the attention of someone quickly skimming through the page to identify a disposal option or instructions for their office supplies and furniture. Here, a banner for the “Reuse-it!” program would be useful in creating program awareness, and would potentially catch the attention of someone who is quickly looking through the page.

Another way to gain access to the “Reuse-it!” website is through the UBC Sustainability website as seen in Figure 15. The first step is to click on the “Campus” tab, followed by clicking on the “Purchasing” option. This will take you to the “Purchasing” page of the sustainability website. As you scroll down, you will see an option to click “Learn More” to learn about the “Reuse-it!” UBC program. This button banner will bring you to the “Reuse-it!” website. This method of gaining access to the “Reuse-it!” website seems to be subjectively more accessible than the UBC Finance website, considering that the “Reuse-it!” program is a sustainable method for purchasing used goods. The banner as shown in Figure 15 that displays the “Reuse-it!” program, could be used as an advertisement tool on the front page of the UBC Sustainability and UBC Finance websites to showcase the “Reuse-it!” program. The only edits that would be required for the banner in Figure 15 would be the text. It needs to be more explicit in explaining that laboratory equipment, office supplies, and furniture, are bought and sold through the “Reuse-it!” program.

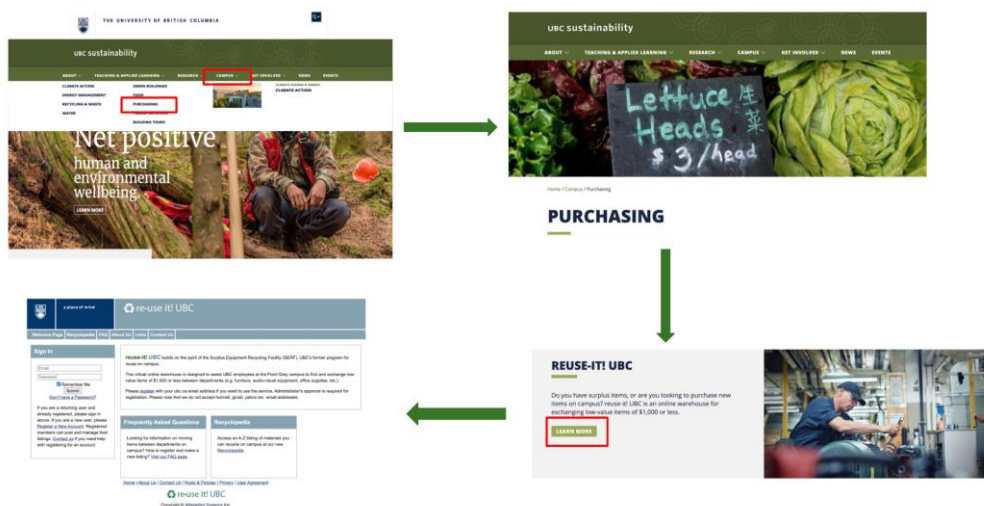


Figure 15 : Accessing “Reuse-it!” from the UBC Sustainability website

In addition to increasing the awareness of the program, when someone visits the “Reuse-it!” website, it would be much easier for them to log in with their CWL as opposed to having to create another account. By streamlining the login process with the customers CWL, the individual would then have an easier time accessing the “Reuse-it!” website and will be more likely to continue using it considering they do not have to keep track of another account, which they would likely have to share with their supervisor or boss if they are not already a faculty member, leading to increased administrative duties and potentially decreasing the likelihood the “Reuse-it!” program would continue to be used.

Finally, to increase the number of individuals participating in the “Reuse-it!” program, it would be highly beneficial to publicly display items that are being sold on the website to attract interest and attention

from potential stakeholders. Currently, you need to log in to the website by creating an account that is separate from your CWL to view what is being sold. By publicly displaying the items that are being sold, and by making the login simple by using a CWL, the number of people using the “Reuse-it!” program could potentially see large increases in participation, especially if the program is advertised through the UBC Finance and Sustainability website and made more accessible on the homepage of those websites.

## 5.2 TRANSACTION PROCESSES

To ensure that customers can trust the “Reuse-it!” program, many steps must be taken to create a robust system, one of which is ensuring the transaction process for buying and selling equipment is clear and transparent in how it is accomplished and in what is being bought. As shown in Figure 6, 45% of customers are unsure of the payment transaction process. To address the issue of uncertainty surrounding the payment transaction process, the payment method must be clear to all stakeholders involved (buyers, sellers, “Reuse-it!” program facilitators), and must have an additional online secure server. Currently, transactions through the “Reuse-it!” program can only be made if the items are worth \$1000 or less. If items are more expensive, the transaction can be made through the UBC Finance website by clicking on the “Procure to Pay” tab and then selecting the “Buy” option, which can be seen in Figure 14. After clicking this option, the page that opens can be seen in Figure 14, in which there are three available options for processing transactions that are under and above \$3500, and above \$75,000. The “Reuse-it!” program must be integrated with these options for purchasing expensive laboratory equipment in order to centralize and streamline the process of buying and selling directly through the “Reuse-it!” program, making it more efficient and trustworthy amongst stakeholders, as customers who are making large purchases may be less likely to do so if they are redirected to UBC Finance or another third party website.

## 5.3 EQUIPMENT RELIABILITY

Additionally, another 35% of those surveyed were uncertain about the possibility of having enough relevant details regarding the quality of equipment they would be purchasing. To address this issue, the “Reuse-it!” program must update the requirements for key information required for each listing. The current requirements for each posted listing can be seen in the “Reuse-it!” website, which was made specifically for office supplies and furniture. To ensure that customers feel they can trust the equipment they are purchasing, the list of the required information must be updated to accommodate the complexity of laboratory equipment. To do this, the following equipment information must be provided by the seller:

1. The equipment retail name, brand, model number, date of purchase, retail price
2. Equipment history
3. Video demonstrations on how to use the equipment
4. Equipment training
5. Equipment standard operating procedure
6. Service contract details (if any)
7. The economic cost of ownership

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### 5.3.1 CASE STUDY 1: REUSE PROGRAM – COLUMBIA UNIVERSITY

The Columbia University lab equipment ReUse Program helps to facilitate the exchange of office furniture and equipment within the university and local community organizations supported by Columbia Community Service to reduce spending across departments and waste from the disposal of usable items. The program is not limited to lab supplies and equipment but includes a wide range of items such as (1) Office furniture: chairs, tables, desk file cabinets (2) Classroom furniture and items: books, light fixtures, chalkboards, whiteboards, smartboards, office supplies, paper, staplers, pens, tape, paper clips, file folders, binders (3) Electronics: AV equipment, computer equipment among many others. The ReUse program operates through a collaboration between the Columbia University’s Office of Environmental Stewardship, Department Administrators across campus, Columbia Community Service, and University Facilities.

The program offers a webpage where equipment owners can post available equipment for donation, and interested recipients can access the site by using their universal university login credentials (UNI). The program offers interested recipients the contact information to reach out to the donors of items they are trying to acquire. The two parties then are responsible for coordinating the transfer of the item(s). Once an item has been successfully reserved, the donor is then responsible for removing the item’s posting from the site and inputs the new recipient’s information as the “current owner” so the program can keep records of their transactions. This program does not offer publicly available information on their source of funding and amounts required to operate, so it is difficult to understand their system used aside from being a donation-based program where transactions occur outside of the program (simply between the two parties). Columbia University’s Office of Environmental Stewardship did not respond to attempts at contact and thus we are only privy to the information offered on their website.

#### Takeaways for UBC from Columbia University

One key aspect of Columbia University’s ReUse Program that could be of interest to UBC is its item posting protocol. In order to build trust between recipients and the reuse program, an acceptable level of quality assurance is required. Columbia University achieves this through a two-part application system for new items to be added to their webpage. They first must submit a document that includes recent images of the item, dimensions and specifications, a detailed history of use, and current condition (list of issues reported). This application is then reviewed. Upon approval, the item is inspected (in person) by program coordinators and is then uploaded and made available for donation. Items with digital memories are required to be wiped using memory-erasing software such as DBAN. From the survey results, we can see that quality assurance was an important issue for the majority of participants and barriers highlighted that would potentially limit adoption of the program included uncertainty of the item's history and condition. Based on these results, implementing a quality assurance system of some form would help build initial trust with potential recipients of used items and could help remove the risk of tainted experiences of unusable or sub-optimal items being acquired through the program.

## 5.4 LOGISTICS AND COORDINATION

At UBC, when buyers and sellers are looking to pair up, the current contact is done primarily by word of mouth. With uncertainty surrounding the likeliness and extent of in-person interactions in the near future, the “through the grapevine” approach has proven to be unsustainable as a primary means of connecting owners and interested recipients. Based on survey findings, social-media posts, including Facebook and Twitter, show low usage rates among participants UBC email seems to be the preferred mode of contact. As pairing buyers and sellers of items is an important aspect of the new reuse program for our survey participants, we recommend contacting potential recipients through departmental email newsletters highlighting available equipment and links to find these items on the webpage. Additionally, these newsletters could be available to anyone who chooses to subscribe to them if their department was not included via a subscription link available on the webpage. The frequency of the newsletters will be determined by the number of postings received. Depending on the volume of items being uploaded onto the program, the newsletter would be disseminated accordingly ( ex: weekly or monthly) and could be subject to change during seasonal spikes and droughts. Additionally posting new items on the homepage of the website could attract passive eyes to view the webpage, increasing traffic. Another important aspect highlighted from other programs is the formation of a “wishlist”. Where interested recipients can input items that may not have been posted yet or are sold out and can choose to be automatically notified once the item they seek becomes available.

The study found no clear consensus surrounding the responsibility of moving items upon transfer of ownership, either by sale or donation. The reason for this was found that survey participants felt it strongly depended on the item. The equipment’s height, weight, distance and transport requirements (ex: extremely fragile items) would ultimately decide the best way for the item to be moved. For items on campus, over a third of participants (38%) reported that they would prefer to pick it up themselves, as recipients, however with the current building access restrictions, cross-departmental exchanges may not be allowed in this method. As far as responsibility for the item’s transport, the survey reported an equal split between sellers and buyers. Furthermore, some participants felt that the responsibility of organizing, and in certain cases paying, delivery should depend on whether the item is being purchased or being donated. If the delivery responsibility was decided to be solely on the equipment “seller”, but they were going to donate the item, it seems like it could discourage donor participants from using the program if they are tasked with coordinating the item’s shipment to a recipient who is receiving it for free. As shown in the next section, many other reuse programs have the equipment owner and recipient coordinate amongst themselves on a case by case basis and can have program coordinators intervene if required.

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### 5.4.1 CASE STUDY 2: CHEM REUSE PROGRAM - UNIVERSITY OF MICHIGAN

University of Michigan’s Office of Campus Sustainability in partnership with Environment, Health & Safety operates the Chemical, Equipment, and Material (ChEM) Reuse Program to divert waste from the landfill and encourage the inter-departmental movement of valuable laboratory-related items. Their unique systems are based on donations from other laboratories at the university that has unused chemical products or laboratory equipment. The initial exchange is that the donor is able to move unused items in their lab to secure storage with pick up coordinated by the Office of Campus Sustainability, and in return, the ChEM program receives the item as a donation to be resold. The system has an online inventory that is updated

with incoming donated items divided into two pages: chemicals and equipment. A form is available on each of the web pages, when buyers find items they are interested in purchasing, they fill out a request form and send it to the program coordinators via email. The details of delivery and fee transactions are developed on a case-by-case basis. Donors must guarantee that their lab equipment is in functioning condition and that chemicals are not expired and properly labeled in approved containers. Additionally, buyers can email the program coordinators to create a “wishlist” of items that they would like to acquire but are not listed in the online inventories. The buyers will then be contacted if or once the item they are seeking becomes available for purchase.

Table 3 : Advantage and disadvantage of ChEM Reuse Program

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• No third-party transaction fee</li> <li>• Flexible payment negotiations</li> <li>• An incentive of free removal and storage of item for donor</li> <li>• The program receives revenue from sales directly (no sellers, just donors)</li> </ul>	<ul style="list-style-type: none"> <li>• High Involvement of Program Coordinators                             <ul style="list-style-type: none"> <li>• Coordinating pickups from donors</li> <li>• Emailing wishlist item updates</li> <li>• Executing payment transactions, negotiating prices</li> </ul> </li> <li>• Storage facility required</li> </ul>

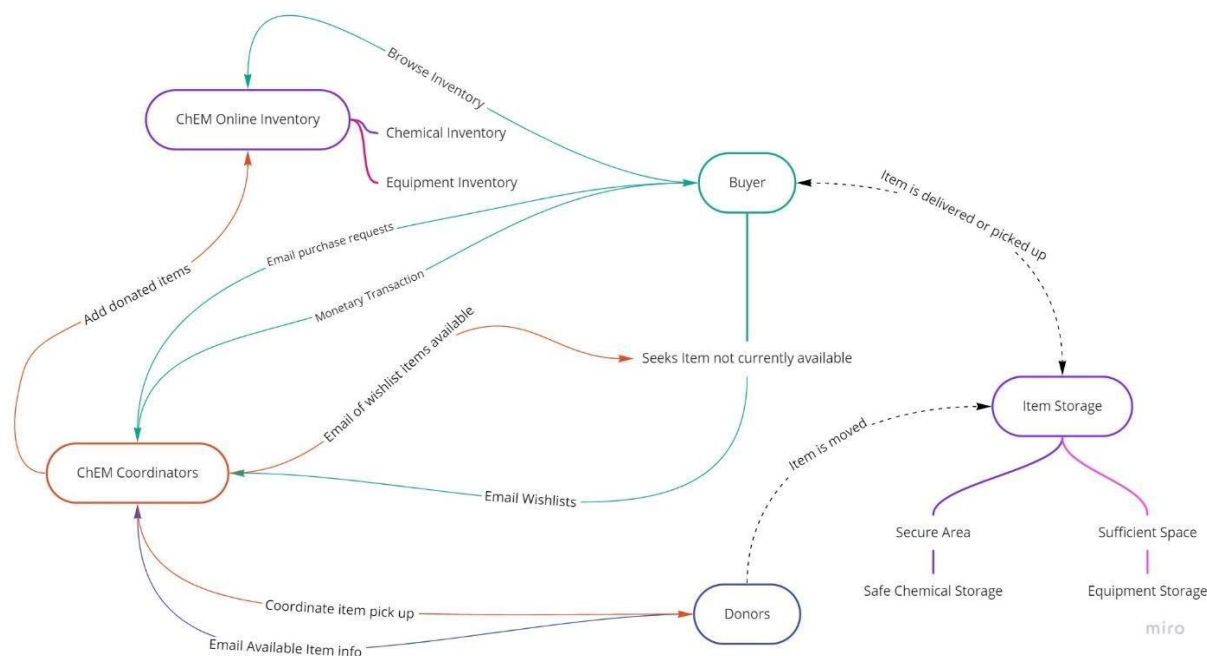


Figure 16 : System map of ChEM Reuse Program at University of Michigan. Dotted lines indicate exchanges of physical items and solid lines mean interactions that occur virtually.



ChEM program has been operational at the University of Michigan since 2011. Prior to this lab equipment reuse program, items were sent to Property Disposition for “rehomeing”. One limitation the program coordinators found of the previous system is that it could not receive expendable (i.e., pipette tips, bottles, centrifuge tubes) nor could it redistribute chemicals.

The storage space used by the ChEM program is a basement space in one of the university’s research buildings where they accept materials, small equipment, and chemicals. The inventory list is available on a Google Form on the program’s webpage and advertising is conducted by word of mouth, the Sustainable Lab Program, and occasional announcements will be made at events with a researcher-based audience. To connect with donors, the program often gets referrals from the Environmental, Health, and Safety (EHS) group that works with lab managers on campus, promoting the program during meetings.

### Takeaways for UBC from Michigan

In the University of Michigan’s FY20 (July 2019 - March 2020 before COVID-shutdown) the ChEM Reuse Program was able to rehome around \$80,000 worth of items weighing about 1,300 lbs (590 kg). The University of Michigan has around 44,700 students and was able to find 70 labs to participate in their program, UBC has around 66,700 students. Though many other different factors are recognized to be at play, the University of Michigan program can at the very least be used as a proof of concept that could be adapted for a slightly larger university such as UBC with the expectation of similar successes. For UBC, this donor system offers an interesting opportunity and would not be as much of a change as one might first think. In fact, as highlighted in the survey results, 80% of our respondents reported already donating equipment internally (to other UBC labs) with another 25% reporting donations made externally (to non-UBC affiliated recipients). This sample data suggests that a donation-based system already exists unofficially at UBC based on current disposal practices but for the system to expand an incentive is likely required. Following the ChEM Reuse system outline, incentivizing donations of lab items through the exchange of picking up lab equipment and storing could be an option to explore at UBC. This idea is supported by the fact that 55% of survey participants that currently have unused lab equipment have it placed in storage. This could mean that it is either in a larger storage area owned or co-owned by the lab, a rented storage space, or taking up usable space in their lab. Offering storage in exchange for equipment ownership allows these lab managers to free up useful lab space, and provides assets to the reuse program to generate revenue from which can be used to offset the associated costs.

## 7. CONCLUSION

This project reviewed the current practices surrounding disposal and reuse of lab equipment at UBC. The study gathered data from key stakeholders around campus regarding their current inventory and disposal habits, and their preferences regarding an updated lab equipment reuse program at UBC. Based on the data collected, the main barriers of adoption amongst survey participants that should be addressed in the new program include quality assurance systems, detailed history of use of items, secure and fair-priced payment transaction systems, among others. Other barriers identified had less technical aspects including overcoming the convenience and habitual nature of purchasing new equipment, and will therefore require a “culture shift” via promotion of the sustainability of the reuse program, and over time, will likely decrease.

An inventory list was compiled to offer insight on items that are currently sought after or available for exchange. Reaching out to more key stakeholders that may not have been initially contacted for data collection or did not participate in the initial round of data collection would help grow this inventory and offer a better understanding of the items on hand at UBC. Moving forward, the items listed will need to be evaluated to see their carbon footprints among other sustainability metrics in order to quantify the diversion of waste from landfills and the associated reductions in greenhouse gas emissions and pollution. Additionally, quantifying the current costs associated with disposal practices and storage of lab equipment items would help to understand the cost to benefits ratio that a reuse program may bring.

The next steps of this project will include deciding on payment transaction systems based on stakeholder preferences which could shift as more participants for data collection are recruited. Additionally, one consideration might be the possible requirement of capitalizing larger assets and this must be discussed with UBC Finance. Columbia University requires capital assets to be filled out for assets (sold or donated) above US\$ 5,000, which could be a similar requirement at UBC. Complexities may arise if the equipment was purchased with grant money where taxes were perhaps withheld.

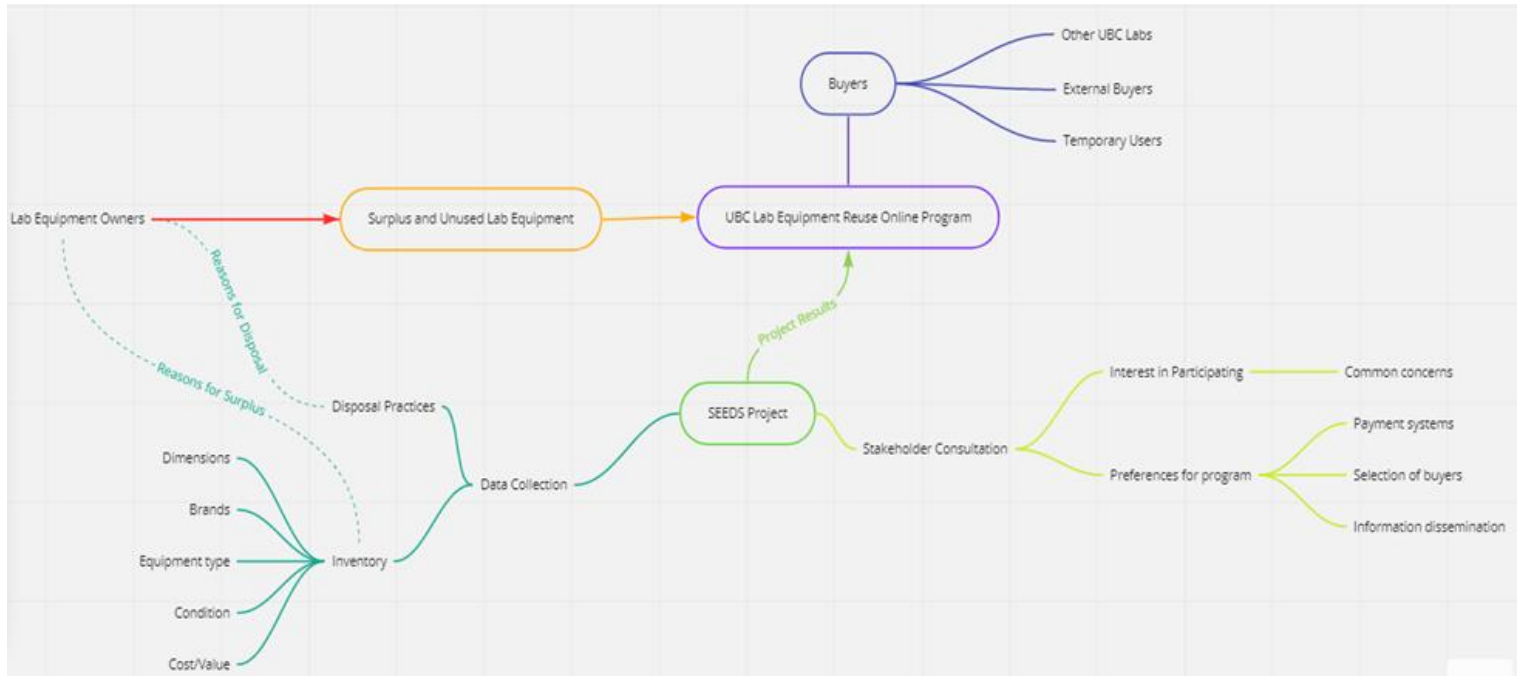
Difficulties related to accessing the older reuse program’s webpage, login requirements coupled with low awareness of the program, in general, must be addressed in order to ensure a higher usage rate of the new program. Awareness is important for program adoption and thus requires targeted and informative promotion. Maintaining contact via follow-ups will be essential during the next developmental steps of the program’s design. Afterward, upon inception, targeted announcements of program-related information will help create a consistent connection with users and enable growth. The new UBC ReUse program will play a key role in UBC’s sustainability goals and our study has found that lab users at UBC are ready to be a part of the developmental process and help establish a leading equipment reuse program in British Columbia.

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## APPENDIX:

## APPENDIX 1: SYSTEMS MAPPING OF THE PROJECT



## APPENDIX 2: SURVEY QUESTIONS

Q1 UBC Sustainability Green Labs has identified that some UBC laboratories have surplus/unused laboratory equipment. This survey will help identify common types of surplus equipment and current handling and disposal practices to better understand how surplus equipment could be reused. For the purposes of this survey, ‘surplus’ or ‘unused’ equipment refers to equipment that is no longer being used in your laboratory and thus could be sold/donated/discarded. All participants will enter a lucky draw to win gift cards up to \$50! If you're interested in participating, please fill out the following short survey. Your contact information will not be shared and your answers will be de-identified. We will follow up with you regarding any surplus equipment that you currently have on hand.

To learn more about SEEDS, visit [SEEDS Sustainability Program](#)

Q2 Please provide the following information:

Q3 Full name

Q4 Job Title

Q5 Email

Q6 Faculty/Department

Q7 What do you typically do with surplus/unused equipment? (Select all that apply)

- Never had unused equipment (1)
- Placed equipment storage or left unused in lab (2)
- Donated equipment to another UBC group (internal) (3)
- Donated equipment to an external group (non-UBC) (4)
- Sold equipment to another UBC group (internal) (5)
- Sold equipment to an external group (non-UBC) (6)
- Exchanged equipment for other equipment at UBC (7)
- Other (Please indicate other experiences) (8)

Q8 If you've ever exchanged laboratory equipment with other researchers, how did you get in contact with them? (Select all that apply)

- I have never exchanged equipment with other researchers (1)
- By word of mouth (2)
- Posted a flyer in UBC (3)
- Sent out an email to potential recipients (4)
- Posted on our group website (5)
- Contacted through social media (6)
- Reuse it! UBC program (7)
- Other online used item platforms (i.e. Kijiji, Craigslist...etc) (8)
- Other (Please indicate which method you used) (9)

Q9 Have you ever acquired used lab equipment?

- Yes (1)
- No (2)

Display This Question:

If Have you ever acquired used lab equipment? = Yes

Q10 If you have ever acquired equipment from other researchers, how did you find out about the equipment that was being offered? (Select all that apply)

- Word of mouth (1)
- Posted flyer in UBC (2)
- Email was sent to me (3)
- Social media post (4)
- Website post from another lab group (5)
- Reuse-it UBC program (6)
- Online used item platforms (i.e. Kijiji, Craigslist...etc) (7)
- Other (Please indicate which method you used) (8)

Q11 Would you be in favour of a lab equipment reuse program at UBC to facilitate exchanges of used lab equipment?

- Yes (1)
- No (2)

Q12 What types of equipment would you consider buying or selling through a UBC equipment reuse platform?

- Refrigerator/Freezer (1)
- Oven (2)
- Scale/Balance (3)
- Centrifuge (4)
- Vortexer (5)
- Sonicator/Homogenizer/Blender (6)
- Hot plate/Stirring plate (7)
- pH meter (8)
- Microscope (9)
- Spectrophotometer (10)

- Glassware (11)
- Other (Please specify all other items) (12)

Q13 What possible barriers or constraints would prevent you from buying used equipment? (Select all that apply)

- Less convenient than buying new (1)
- Difficult to find items that meet exact needs (2)
- Unsure of quality (3)
- Would need to know the history of use (4)
- Difficult to coordinate logistics for an exchange (5)
- Unsure of payment transactions (6)
- Potential added complication of buying from a non UBC-recognized seller (7)
- Other (Please specify all other barriers) (8)

Q14 What possible barriers or constraints would prevent you from selling used equipment? (Select all that apply)

- Difficult to coordinate logistics for an exchange (1)
- Unsure of payment transactions (2)
- Unwilling to negotiate the price (3)
- Possibility of not having relevant details about the equipment (4)
- Potential added complication of selling to a non UBC-recognized seller (5)
- Other (Please specify all other barriers) (6)

Q15 Does your lab have equipment that is no longer being used that you would like to sell/donate?

- Yes (1)
- No (2)

Display This Question:

If Does your lab have equipment that is no longer being used that you would like to sell/donate? = Yes

Q16 Please indicate the equipment quantity that you have that are no longer being used for each of the below categories (Indicate the quantity in numbers or N/A)

	No. of Equipments in excess (1)
Refrigerator/Freezer (1)	
Oven (2)	
Scale/Balance (3)	
Centrifuge (4)	
Vortexer (5)	
Sonicator/Homogenizer/Blender (6)	



Hot plate/Stirring plate (7)	
pH meter (8)	
Microscope (9)	
Spectrophotometer (10)	
Other (Please specify all other item names and quantities) (11)	

Q17 What aspect of an equipment reuse program would you like UBC Sustainability to facilitate? (Select all that apply)

- Helping pair sellers with buyers/recipients (1)
- Facilitate payment transactions (through a web service) (2)
- Advertising available lab equipment internally at UBC (3)
- Advertising available lab equipment externally (for buyers/recipients outside of UBC) (4)
- Others (Please indicate other options) (5)

Q18 Would you be willing to pay a transaction fee for the UBC reuse platform when buying/selling used equipment (5-10%)?

- Yes (1)
- No I would rather coordinate transactions outside of the platform (2)

- No, that is too much of a transaction fee (3)
- I am not interested in an online UBC equipment reuse platform (4)
- Other (Please specify) (5)

Q19 When buying equipment through the reuse platform, what would be your preferred method of delivery?

- Self-pick up within or around UBC (1)
- Recipient must coordinate pickup or delivery (2)
- Seller must coordinate delivery (3)
- Flexible (Depends on equipment) (4)
- Other (Please specify) (5)

Q20 Have you previously used the "Reuse-it!" UBC online platform for buying/selling/donating used lab equipment?

- Yes, it worked well (1)
- Yes, but I would not use it again (2)
- No, I have never heard of it (3)
- No, it was a difficult to use interface (4)
- I have used it, but never for lab equipment (5)
- Other (Please specify) (6)