University of British Columbia

Social Ecological Economic Development Studies (SEEDS) Sustainability Program

Student Research Report

Developing a Framework for a Circularity Analysis at UBC

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Res 505, SEEDS Project

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Executive Summary

The idea of a circular economy (CE) has captured the interests of academics and decision-makers as the world attempts to shift towards sustainable economic systems. Circularity identifies opportunities to design out waste and enable better resource management by recovering materials at a product's end-of-life. A circularity analysis assesses the current state of material flows and identifies opportunities to increase the circularity of a specific item, sector, or system. A circularity analysis within a specific case is a useful preliminary step in shifting to circular practices, but what inputs are needed for a circularity analysis are unclear and context dependent. This research aims to support the University of British Columbia (UBC) with the development of a circularity analysis by drawing on best practices from other institutions and exploring the context-specific factors within UBC.

We utilize a document analysis, observations, and semi-structured interviews with both key external stakeholders who have experience conducting circularity analyses, as well as internal stakeholders whose work relates to a transition to circularity. We explored the factors that were key to the success of circularity analyses at other institutions, as well as the challenges they encountered, and specific learnings from their experiences. We used this data to inform our interviews with internal stakeholders in order to determine how these learnings could be adapted to the UBC context.

We found that, contrary to much literature on the need for pre-defined indicators, most circularity analyses have been conducted iteratively. Rather than determining the optimal indicators, the circularity analyses we encountered began with preliminary metrics that were refined over time. These preliminary metrics were applied to specific pilot projects, which were

then recreated with other targets after incorporating prior learnings. This progressive build-up of small projects, rather than one large analysis, was the preferred method of most external respondents. It also appears that quantitative metrics were less important for practitioners than has been expressed in the literature; a larger emphasis was placed upon fostering engagement with the broader student and administrative community, as well as procuring the necessary resources to conduct a circularity analysis. Ensuring that these resources are available is a major prerequisite for success.

From our findings, we provide a number of recommendations, which include the creation of a circularity committee, the creation of a shared definition of "circularity", engagement with the student community, and support of current circularity initiatives on campus. As detailed in the discussion and conclusion, these recommendations are provided as guidelines for future actions and research to support UBC in its transition to circular operation.

1.0 Background (Literature review)

In the last few years, the concept of circular economy (CE) has been greatly addressed in academic literature as circularity is increasingly considered a key element in the achievement of sustainable economic systems (Stumpf et al., 2021). As highlighted by Sillanpää and Ncibi (2019), the concept refers to a practice which is far from new to humanity. Humans experienced circularity for centuries in an instinctive and spontaneous manner via their integration in natural systems. More recently, a shift in human relationships with nature stemming from technical, agricultural, and industrial revolutions have led to consumption characterized by overexploitation of natural resources, and consequent generation of waste (Delchet-Cochet, 2020).

Although it is not possible to precisely identify the first users of the concept "circularity", its incubation occurred within the discipline of environmental economics in the early 1960s (Sillanpää and Ncibi, 2019). Since then, circularity has been presented as an alternative to the predominant economic model based on "taking, making and disposing" (Ness, 2008) and it is generally regarded as a paradigm enabling greater efficiency of resource use and thus an important means to achieve sustainability (Ghisellini, 2016). One of the most cited definitions of CE is from Kirchherr et al. (2017), who describe CE as "…an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials."

While Kirchher's definition provides a general idea of the main features of a circular economy, some clarification is needed, especially when it comes to the term 'recycling', which is slightly controversial. For instance, it should be noted that, although most municipalities in North America collect plastic waste, only a small percentage of this waste is actually recycled (McCormick et al., 2019). In 2019 alone, it is estimated that 68,000 containers with plastic recycling were shipped from the US to developing countries, where they are often dumped in open landfills (ibid). The complex global trade in waste between the global North and the global South has been at the center of multiple debates and it has raised important questions on social and environmental justice (Gragson and Crang, 2015). In this context, a shift to circularity is even more urgent.

For this reason, the concept of circularity has gained traction in policymaking. In recent years, the European Union has been working on legislative texts, action plans and frameworks with the aim of promoting a circular economic model (Völker et al., 2020). Although a specific

directive on circularity is yet to be drafted, every EU policy area mentions the circular economy, and €964 million have been allocated to projects on circularity (ibid).

A shift towards circularity is also present in specific industries. Soo et al. (2021) found significant effort to adopt circularity practices in the vehicle material industry, especially in regions where regulations encouraging material reuse were present.

Most studies on circularity have focused on industrial waste disposal and environmental economics, while less research has been conducted on circularity analysis, namely the identification of methods and procedures for a successful implementation of CE. Circularity assessments are crucial steps for implementing circular economy measures. Indeed, the Ellen MacArthur Foundation (2020) claims that it is difficult to create a circular economy without first measuring it. Marianne Richeux, the Zero Waste World Program Lead, has reported a serious lack of adequate measurement parameters to assess circularity and to form guidelines for implementation. The lack of adequate measurement frameworks represents a barrier for companies and institutions to effectively calculate their impact and consequently work towards meaningful progress.

For this reason, the identification of circularity indicators as analytical tools to develop a CE is imperative (De Oliveira et al., 2020). However, there is open and ongoing debate about which metrics are most suited to indicate circularity, which has led to various, subjective methodological frameworks for evaluating implementation strategies (Rocchi et al, 2021). In their analysis of existing literature on circularity, De Oliveira et al. (2020) found that most literature focuses on indicators for material and resource recovery, but they lack robustness in terms of implementation of a comprehensive circular economy. More specifically, 66% of the articles reviewed by the authors assessed circularity through the adoption of nano-level

indicators, which are best suited for products. Niero et al. (2019) observe that different indicators for circular economy performance have been identified by various authors (e.g., production efficiency, utilization efficiency, recycling rates) but publications in this regard have been scarce. Many authors mostly focus on the identification of material circularity indicators like intrinsic recyclability (percentage of a product that can be recycled at least once) and recycled content (percentage of a product that is already recycled), but less attention has been paid to meso and macro-level indicators, which would be helpful for assessing circularity on a larger scale (Niero et al., 2019). This is partly because the development of this economic model has largely been undertaken by practitioners rather than scholars (Korhonen et al, 2018).

To assess circularity, many authors propose a material flow analysis (MFA), which matches the use of resources and production of waste with the capacity of the environment to supply those resources and absorb waste (Jacobi et al., 2018; Mayer et al., 2019). The aim of this approach is linking inputs (resources), outputs (waste), and Greenhouse Gas (GHG) emissions, thus providing decision makers and practitioners with a set of comprehensive data, instead of considering each element separately (ibid). However, such an approach is often deployed on a large scale by countries or sizable jurisdictions like regions and provinces (Kovanda et al., 2008; Raupova et al., 2014; Jacobi et al., 2018). Some institutions and smaller jurisdictions use an approach called “circularity gap index” (CGI). The Circularity Gap Index calculates the share of material waste which is not converted into new resources, and thus does not re-enter the economy as recovered material (Aguilar-Hernandez et al., 2020).

MFA and CGI are both useful instruments to calculate circularity within a determined system, but they are still highly sector-specific and do not provide general guidelines to assess CE. In fact, they mostly provide guidance to assess circularity in sectors like waste recovery and

generation, but they are unable to offer a general framework, which might instead be helpful to conduct a comprehensive circularity analysis (ibid).

The identification of universal indicators to conduct a circularity analysis is rendered even more complex by the fact that different indicators might serve different purposes, which makes them highly contextual (Niero et al., 2019). Thus, it is of high importance to contact institutions who have already undertaken circularity analyzes to determine best practices and learnings that can be applied to the UBC case. Guidance from organizations like the Ellen MacArthur Foundation will also be useful. The Circulytics platform is of particular interest. This resource supports a company or institution by revealing the "…the extent to which a company has achieved circularity across its entire operations"[1] (Ellen MacArthur Foundation, n.d.). Free resources are available to measure circularity performance and highlight blind spots and strengths (ibid). This may provide insight into what indicators are generally useful for measuring circularity generally.

More specifically, the Ellen MacArthur Foundation identifies eleven areas which should be considered when assessing circularity. As shown in the table reported below (Fig. 1), institutions should gather data from different sectors, namely strategy and planning, innovation, people and skills, operations, external engagement, products and materials, services, plant property and equipment assets, water, energy, and – if applicable – finance (The Ellen MacArthur Foundation, n.d.). While these broader sectors provide a general guideline for institutions to calculate circularity, the foundation itself warns that they should not be taken out

[1] https://ellenmacarthurfoundation.org/resources/circulytics/overview

of context. Therefore, they must be distilled to the UBC context to determine the most beneficial, case-specific indicators.

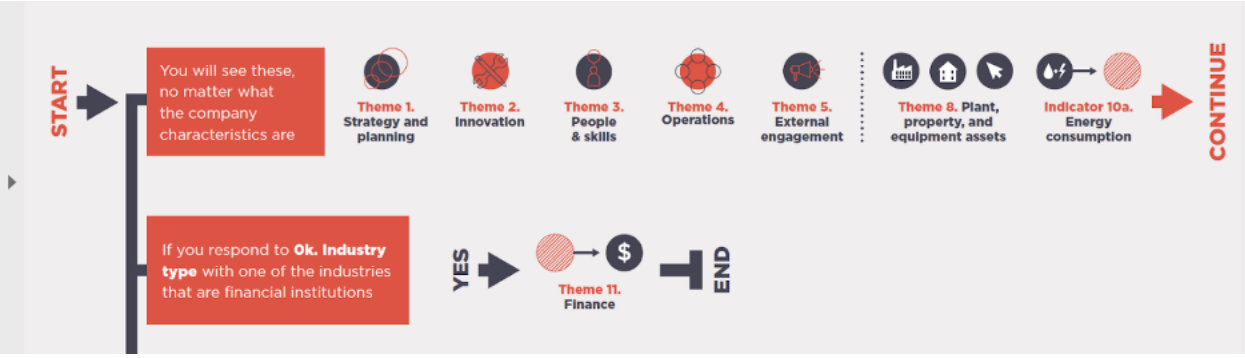


Fig. 1. The Ellen MacArthur Foundation (n.d.). Circulytics.

After a thorough analysis on existing literature, it is apparent that there is a gap in understanding of what makes a good circularity analysis. It is impossible to create a circular economy without first measuring it, but what needs to be measured is unclear (Ellen MacArthur Foundation, 2020). Our research seeks to determine the characteristics of a successful circularity analysis, as well as to provide insight into how such an analysis should be undertaken in the UBC context.

2.0 Research Questions

- How have other large institutions (post-secondary institutions, non-profit organizations, municipalities) conducted circularity analysis?
  - What was the process?
  - What data inputs were used?
  - Who were the stakeholders involved in spearheading the process?

- What types of data exist within the UBC system that could be used as input for a circularity analysis? Who stewards the data? What types of necessary data are missing?

3.0 Methods

The core aim of this study is to determine the best practices for conducting a circularity analysis at UBC. We employed a three-pronged approach to data collection, using a combination of document analysis, semi-structured interviews and participant observations to explore sustainability efforts such as zero waste goals at UBC, and to understand the process of conducting a circularity analysis. The document analysis provided insights on the process institutions have undertaken in conducting a circularity analysis. We analyzed the websites and reports produced by large institutions such as post-secondary institutions (e.g. McGill University), non-profit organizations, and municipalities who have conducted some form of circularity analysis (e.g. the city of Montréal). Eligible institutions were identified using a scoping search within academic libraries and guidance from our (Social Ecological Economic Development Studies (SEEDS) partners. This document analysis was focused on highlighting the types of data inputs used in conducting circularity analysis, the stakeholders involved in conducting the analysis, and the roles various stakeholders played in facilitating the analysis.

Semi-structured interviews were conducted with stakeholders at large institutions (post-secondary institutions, municipalities) who have conducted a circularity analysis. These individuals were identified through our document analysis. Our initial scoping search identified Quebec as an area which has made significant progress towards conducting a full circularity analysis. We contacted the EDDEC Institute management team which led the research and development process for a group of schools in the province looking to transition towards circularity. Additionally, McGill University has developed a sustainability strategy that

highlights the need for a circular economy. We reached out via email to the sustainability managers and sustainability officers who've been part of developing and implementing the sustainability plan. During these in-depth interviews, we sought to gain a detailed and nuanced understanding of the process of conducting a circularity analysis and the experiences of participants. Our questions were designed to encourage our participants to describe the specific steps that were taken by their institutions from the conception stage to the completion of the circularity analysis. We probed for the types of data-sets and skill-sets that facilitated the completion of the analysis (see appendix for interview guide). We also inquired about the challenges they encountered and the lessons they learned in the course of their analysis.

We also interviewed stakeholders within the UBC community who showed interest in having a circularity analysis done at UBC. These stakeholders were identified in collaboration with our SEEDS partners, who provided suggestions for partnerships between students, staff, and community partners to advance the circularity work on campus. We discussed their ideas on the opportunities for circularity and the challenges they anticipate in conducting a circularity analysis at UBC. We used a snowball sampling method, harnessing the contacts of our participants to identify additional stakeholders with information on the kinds of data collected by the university and available to be used in a circularity analysis. We also inquired about the types of data that are not readily available and ways they can be approximated or replaced.

All participants were interviewed using Zoom and were informed that their participation was strictly confidential. Interviews were recorded and transcribed by members of the study team, with minor edits made to remove potentially identifying information about the respondents (see appendix for consent form).

We conducted observations of the building operations team meeting and the AMS operations committee meeting. In these observations our focus was on how issues relating to circularity are discussed in the UBC context.

We conducted a thematic analysis of our interview data. The analysis occurred in stages. All team members conducted an initial review of transcripts for familiarization and identification of key themes. Team members then paired up and conducted a thematic coding of the same transcript to ensure inter-coder reliability. The final stages involved having a team meeting to discuss and synthesize themes for interpretation.

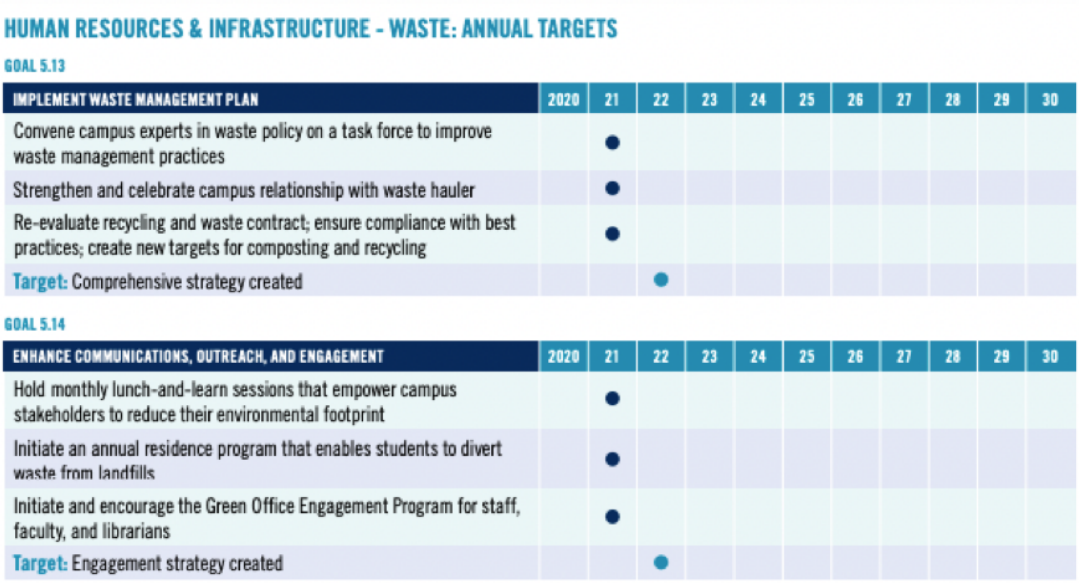
4.0 Results

4.1 Document Analysis

The document analysis consisted of 11 documents, mainly from institutions and various levels of governments (municipal, provincial, and federal). The documents that we were looking for targeted institutions that were similar in size with the UBC campus. University institutions and municipalities in Canada were the first searches we did. The types of documents that were analyzed were sustainability plans and zero waste strategies as keywords such as “circularity” and “circular economy” were most commonly found in these documents. Our document analysis provided us with knowledge on existing circularity research and programs and expanded our research themes and scope for our interviews. Through our document analysis, it became apparent that “circular economy” is a fairly new concept which institutions and governments are incorporating into action plans and strategies to meet waste and greenhouse gas reduction targets. We sought to identify what research exists on conducting circularity analyses, as well as what gaps remain. Our document analysis was conducted by three members of the team and used the

same template for each of the documents. The information we looked for in our documents included: a brief summary, timeline, targeted sectors, approaches/methodologies, data inputs, indicators to measure process, challenges, facilitators (people in charge of the circularity projects), and potential contacts for interviews. We used that as a starting point to guide our research on how to conduct a circularity analysis at UBC.

Our first finding from our document analysis was that action plan and strategy timelines ranged from 2025 to 2050 for their waste goals regarding circularity to be completed. Seven out of the 11 documents did not include specific timelines or dates for their goals. The City of Peterborough in the United Kingdom developed a Circular City Maturity Model that outlined the basic steps to be more circular including circular economy indicators and metrics (Opportunity Peterborough, 2018). Thus, they were taking a progressive approach to become fully circular by 2050. The remaining documents with timelines were from university institutions with timelines that have either been already completed or have plans to be completed by 2035 (McGill University, 2020). One of the more detailed timeline examples was from the University of Toronto's Mississauga campus as seen in Figure 2. However, it does not specifically outline any work on circularity directly. Rather, the steps for the creation of their Comprehensive Strategy have a focus on waste diversion, which supports a circular economy (University of Toronto, n.d).



HUMAN RESOURCES & INFRASTRUCTURE - WASTE: ANNUAL TARGETS

GOAL 5.13

IMPLEMENT WASTE MANAGEMENT PLAN	2020	21	22	23	24	25	26	27	28	29	30
Convene campus experts in waste policy on a task force to improve waste management practices		●									
Strengthen and celebrate campus relationship with waste hauler		●									
Re-evaluate recycling and waste contract; ensure compliance with best practices; create new targets for composting and recycling		●									
Target: Comprehensive strategy created			●								

GOAL 5.14

ENHANCE COMMUNICATIONS, OUTREACH, AND ENGAGEMENT	2020	21	22	23	24	25	26	27	28	29	30
Hold monthly lunch-and-learn sessions that empower campus stakeholders to reduce their environmental footprint		●									
Initiate an annual residence program that enables students to divert waste from landfills		●									
Initiate and encourage the Green Office Engagement Program for staff, faculty, and librarians		●									
Target: Engagement strategy created			●								

Figure 2. University of Toronto's waste reduction goal timeline (University of Toronto, n.d).

As well, the most common sectors that were targeted for action were waste management, procurement, construction, and food services. The ability to track material flows and volume of resources was the reasoning behind selecting these sectors as they have the potential to experience significant reductions with the implementation of a circular economy.

The scope of our project was specifically concerning approaches and methodologies for conducting a circularity analysis. In our document analysis we looked for prior examples to investigate and gain knowledge from. From our analysis, we identified these common approaches:

1. Conduct a study of the existing systems in place (i.e. waste audits, consultations, life cycle analysis, landscape analysis),
2. Establish a working group or committee,
3. Data collection and analysis,
4. Work with relevant partners (i.e. waste haulers to ensure that they understand the community of practice and comply to the appropriate waste management practices), and

5. Engagement and education to the public/targeted audience (i.e. students)

To conduct a circularity analysis, it is important to identify what data will be used and the indicators or metrics required to measure success and progress. From the document analysis, the majority of the documents did not specify what data inputs will be/were used. Only Quebec's Circularity Gap Report has conducted a full circularity analysis and included the types of data that was used: extraction of natural resources, imports, exports, emissions, dispersed and dissipated materials, and waste data (Circle Economy, 2021). Thus, alternate data inputs are yet to be proven effective or useful at conducting a circularity analysis.

Lastly, our document analysis examined the challenges associated with circularity analyses. Since many of the institutions and governments have not yet conducted a full circularity analysis, they did not identify challenges. However, the organizations that have undertaken some circularity initiatives noted similar challenges, mainly revolving around data collection and availability challenges, stakeholder inertia, and little return on investments. The complexity of the issue was an overarching challenge as this is a fairly new concept that has yet to be implemented. Businesses and institutions are starting to shift and realize the importance of circularity, however, roles and responsibilities have yet to be defined creating the challenge to start the work in circularity. Overall, the findings from our document analysis guided the questions for our interviews and provided insight for our project to help UBC identify useful approaches for a circularity analysis.

4.2 Interviews and Observations

We had ten participants including three external stakeholders and seven internal stakeholders from across the UBC campus. Our participants were involved in eight semi-structured interviews, including two which employed the use of photo prompts and one focus group.

We also observed a zero- waste action committee meeting and a lunch and learn event hosted by the Graduate Student Society and a Zero Waste Coordinator from Campus and Community Planning for UBC students that are interested in living a more sustainable lifestyle.

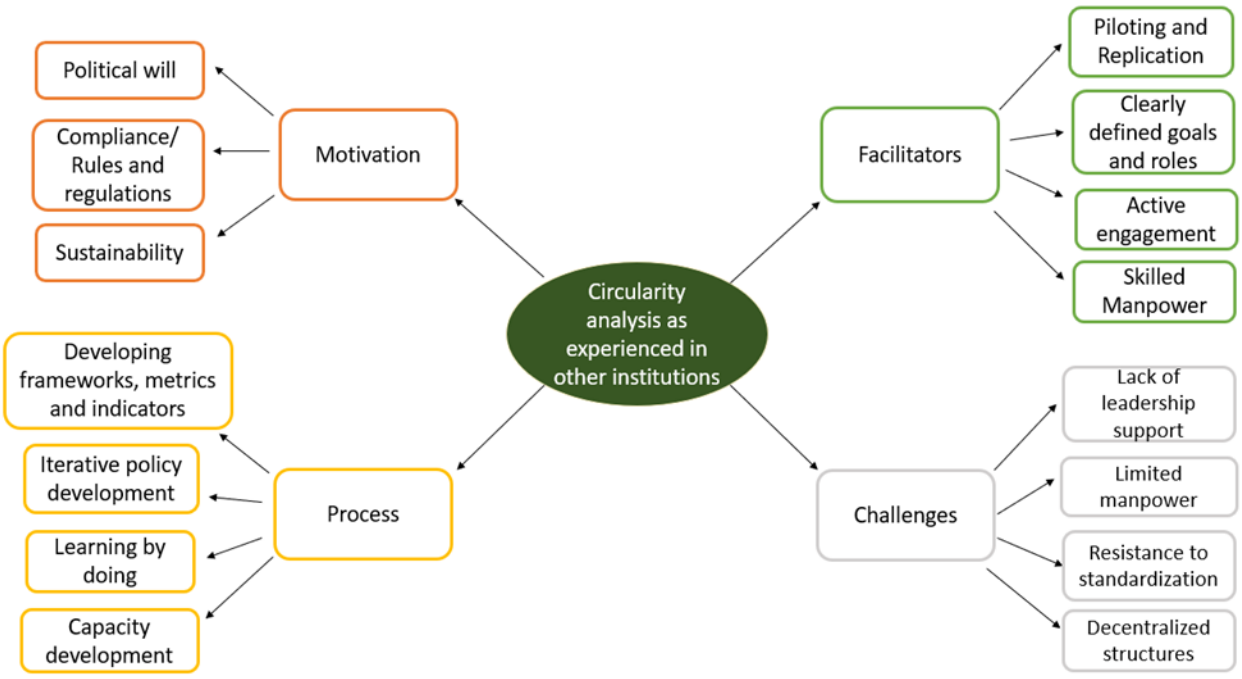


Figure 3. Thematic map showing core themes and sub themes that describe the experience of conducting circularity analysis in external institutions. Developed by author team (2021)

Exploring the external stakeholders' perspectives

Motivation: The external stakeholders described the presence of 1. Political will, and 2. Existing rules and compliance factors along with sustainability concerns as key motivations for conducting a circularity analysis and engaging in more circular processes. They expressed the idea that while the desire for sustainability was a useful driving force, the need to comply with the rules of granting agencies and the province provided a significant push towards a more careful tracking and management of assets within the institution.

"There's sustainability objectives for sure. But we're also using compliance as a driver. Right? In case not everybody's on board with just the sustainability aspects. So, compliance to the granting agency rules and programs and compliance with the provincial government expectations that we track and manage and ensure the longevity of certain assets" – Respondent 5 (Procurement, McGill)

Process: We also identified a number of key factors that are core aspects of the process of conducting a circularity analysis. They include; developing frameworks and metrics, iterative policy development, learning by doing, and capacity development. Participants expressed the need for identifying frameworks, metrics and indicators that fit within the specific institutional contexts. Additionally, the need for an iterative process was consistently emphasized to ensure the process was flexible enough to allow for new learnings to be incorporated along the way. They also described the process as complicated and extensive, requiring the development of human (e.g. advisory committees, skilled experts, etc.) and financial capacity to effectively facilitate it.

"So, before we got into an analysis, we look at different frameworks already used. And we sort of did a literature review and what worked, what was completed, or what were the common elements between those frameworks. And we decided to go with our own framework rather than following one, because they were not necessarily in line with what we wanted to do." – Respondent 8 (Researcher, Quebec College)

"It was so complicated and such a big undertaking that we've been going at it very incrementally. We're going at it per asset category and then we're learning as we're doing" -Respondent 5 (Procurement, McGill)

Challenges: Our external stakeholders also faced a number of key challenges broadly described under the themes of 1. Limited human resources, 2. Resistance to standardization and 3. Decentralized structures. As previously described, the process of conducting a circularity analysis is extensive, and thus requires some dedicated human resources to facilitate it; the absence of that resource was identified as a significant challenge. Our respondents explained that it was often useful to standardize some practices (e.g. procurement, asset management, etc.) across the university, however, this was occasionally met with resistance. The decentralized nature of university systems was identified as a significant difficulty by our external stakeholders. The fragmented approach to data collection and data stewardship meant that there was often no singular data repository and thus identifying the various data stewards and engaging them in the process was a necessary but often tricky and time consuming first step.

"Universities are so huge and decentralized, it's hard to get everybody to know what this is and how it's working" – Respondent 5 (Procurement, McGill)

"So, without strong support, but also like dedicated people, so like, Sustainable Development, office or person, you know, that it's their job to do that kind of analysis. And it is mandated, I think it's really hard to work around that."- Respondent 10 (Circularity researcher)

"There's been some resistance, not to circularity or to sustainability, it's resistance to control from the central administration… every once in a while, we'll run into people who are like well, I don't want to tell you what I have and why should you be controlling this and I want to do my own thing"- Respondent 5 (Procurement, McGill)

Facilitators: Our external stakeholders also described a number of key factors which support the process of conducting a circularity analysis. Participants found these helpful for mitigating the challenges they experienced, or expressed that they would be useful for other institutions looking to embark on this process. Four core themes describe their ideas; piloting and replication, clearly defined goals and roles, active stakeholder engagement, and skilled human

resources. Given the complicated and extensive nature of the process of conducting a circularity analysis, our participants highlighted the value of starting with pilot projects in smaller sections of the system, learning from the process as described earlier and then replicating that in other parts of the system. Additionally, our stakeholders highlighted the need for engaging with stakeholders in various sectors of the system and people who have the necessary skills to facilitate the process.

"The first initiative that we had was tackling the lifecycle and optimizing the lifecycle of our IT assets. And then when we got that done, we realized, wait a minute, there's like a framework here. And a process that can be replicated with other asset categories" – Respondent 5 (Procurement, McGill)

"So hence, we have to go for the data, we went around to create an advisory committee. Because it's a very complex subject, we really want to be sure to have a committee that could help us to give us the latest data, the best insights on the different parts of the report to give us comments and wisdom on their different fields to help us. So, we created a committee with about, I think, 11 people. And that was quite a challenge." – Respondent 1 (circularity officer, Montreal)

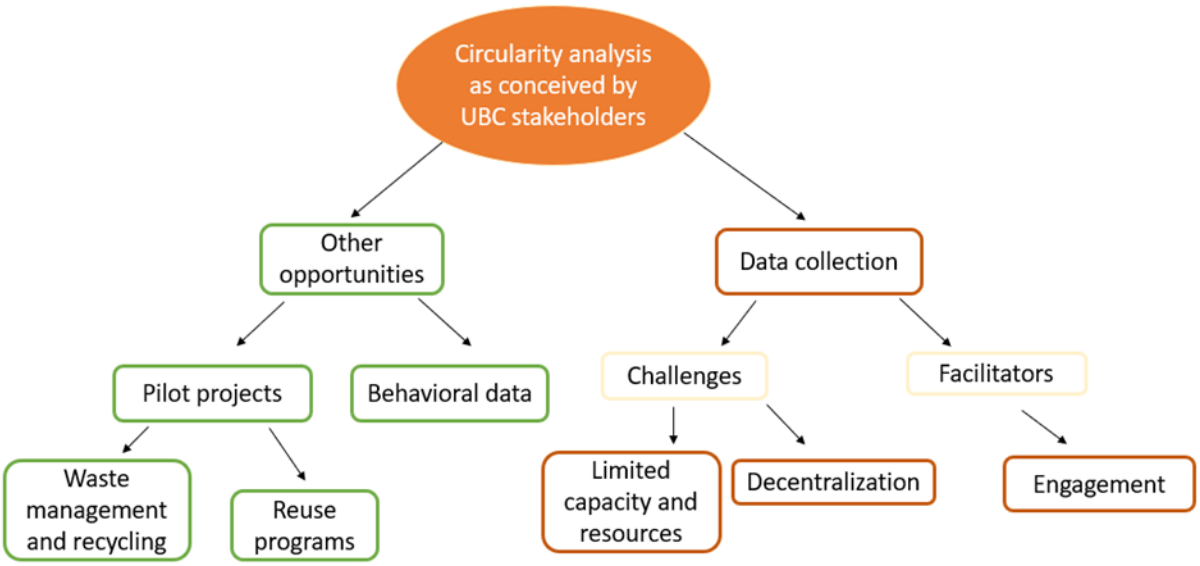


Figure 4. Thematic map showing core themes and sub themes that describe stakeholders' perceptions of the steps to conducting a circularity analysis at UBC. Developed by author team (2021)

Exploring internal stakeholders' perspectives

Our interviews with UBC stakeholders provided us with insights into the ideas around data collection, and opportunities for improving circularity, and the kinds of data available.

Data collection: With regard to data collection, limited capacity and resources, as well as decentralization were identified as key challenges. The resource constraint was in many ways the key challenge, making it difficult to employ the human resources needed to facilitate circularity initiatives and collect/collate the data necessary to conduct a circularity analysis.

"procurement is semi decentralized at UBC so we have we have Financial operations which has procurement officers which do a lot of work in procurement and then they have staff that are embedded in different departments and faculties that do procurement as well and then there's also another level of procurement which is just done by individuals who could be like a departmental administrators who work for faculties and departments and that procurement is not necessarily going through any kind of centralized process, it is very decentralized and very independent and so that's probably one of the hardest areas to get at because I don't know I don't know if there's any easy way to collect data"- Respondent 2 (planning and sustainability, UBC)

"I think it's not a challenge of commitment, but a challenge of resources that back that commitment. So UBC I think has a very strong declaration on what is important and that's the right direction but I feel like at times we could do a little better in terms of committing resources towards getting us there. I think it's a little understaffed and underfunded. I'm going to choose one example of creating a recycling space on campus. The fact that we don't have a physical space and I know it requires higher commitment and financial backing towards it but I think there's a need but it's challenging to convert these great ideas into commitments, marrying the commitments to the ideas is a challenge." –Respondent 4 (sustainability, UBC)

Other opportunities: A number of opportunities were also identified, especially through pilot projects and behavioral data. Our stakeholders noted that a lot of data exists on the impacts and perceptions of various sustainability related pilot projects going on across campus.

"We have a lot of audits in terms of compost data, when it comes to students composting, and a lot of it's based on student behavior or staff behavior." – Respondent 6 (sustainability, UBC)

"I think that there's a lot of data on, like student perceptions, and how students react to certain pilot projects, initiatives on campus, and just what they see what they notice, I think a lot of data on that will be pretty, pretty accessible" –Respondent 6 (sustainability, UBC)

Participant observations

Our observation of the zero- waste action committee provided us with useful insight into the experience of data collection across campus. We observed that there seems to be very limited standardization of data across departments; data collection was described as an activity embarked upon by departments based on their very specific needs. Data was not collected with the aim of feeding into a larger process like a circularity analysis. However, within departments there appeared to be a focus on collecting relevant data to inform or evaluate various ongoing initiatives and pilot projects.

Our observation of the lunch and learn event on zero waste and sustainability showed us the work that is being done around familiarizing the student community with work related to waste reduction, to ensure that the UBC community is able to participate actively in the process of careful waste management to support the goals set by the university.

Overview of recurring themes

Across our interviews with internal and external stakeholders and observation of the zero-waste committee, using pilot projects was identified as a valuable tool for learning in the process of transitioning towards circularity. Additionally, the decentralized nature of universities was a common challenge and resulted in the need for human resources that are focused on

implementing circular processes and engaging with various data stewards to facilitate data collection for a circularity analysis.

5.0 Discussion

The following section unpacks some of the report's key findings in greater detail. Final recommendations will be outlined in section 6.0. Table 1 provides a breakdown of the main insights gleaned from interviews and which institutions these insights came from.

Table 1

Key insights	**Source**
Creation of a committee can be valuable way of bringing relevant voices around the table and keeping the process moving along	Quebec Province
Create at least one staff role to work on circularity	McGill University
Involve at least 2-4 people (academics) if conducting a Life Cycle Analysis	Quebec Province
Circularity analysis teams of 1-4 staff	Quebec College
Create a context-specific definition of "circularity"	McGill University Quebec College Quebec Province UBC Staff
Identify department or material(s) for pilot	McGill University
Develop indicators for measuring circularity and develop baseline data *as you go* (Baseline data should focus on where things come from, who decides how they are processed, who tracks them and eventually how are they transferred, what are the removal logistics)	McGill University Quebec Province
Engage students	McGill University UBC Staff

Engage university leadership and get support	McGill University Quebec College UBC Staff

5.1 Piloting as blueprint

5.1.1 The significance of context

This research sought to understand how to best conduct a circularity analysis in the UBC context. The process of conducting a circularity analysis and implementing circular economy measures often begins at a small scale. Typically, an initial inventory of specific materials, for example IT equipment, is undertaken. These are then tagged and tracked throughout their lifespan, including at the potential disposal or reuse stage. This provides a clear picture of how items are used, for how long, and how they are dealt with at end of life. In doing so, a more accurate picture of the circularity, or lack thereof, of specific types of items is gained, which provides useful information on the current state of circularity for that given case. Ideally, these pilot projects can then be undertaken with other items and in other departments, eventually scaling up to university-wide analyses. It is worth noting that piloting already takes place in some settings at UBC, with waste and sustainability projects first trialed at a small scale to assess their efficacy, before applying them across the university. Niero et al. (2019) argue that it can be challenging to identify a set of universal indicators to conduct a circularity analysis, since indicators tend to be contextual. Context is therefore important insofar as institutions can develop their own circularity analysis framework to meet their needs. For example, as part of their circularity analysis, Quebec took stock of high level inputs like fishing, forestry, and agriculture and then sought to understand how these inputs translated into the province's waste output. This

high-level approach to a circularity analyses could form part of UBC's strategy, but would clearly need to be adapted to fit the UBC-specific context.

On the other hand, small-scale pilots for doing a circularity analysis, with some flexibility and adaptability built-in, can also be used for a variety of materials and material objects, irrespective of context. Conducting an analysis and implementing circularity measures at the level of an individual item (e.g. IT) can be replicated for other items and item groups, such as furniture and appliances. As one external participant highlighted:

"There's different people, different stakeholders, different issues. But for me, now it's much easier because I have the blueprint of what I need. I know I need my stakeholder groups, I need to issue the roles and responsibilities, who's going to be the asset steward, who's going to be the asset administrator taking care of the inventory, and then we need to have people at the back end to determine what's our reuse eligibility criteria. Then you have to find logistics, we have our list for internal reuse loops then we go hunting for external reuse loops" - Respondent 5 (Procurement, McGill)

While it may not be possible to develop a "one size fits all" approach to conducting a circularity analysis at an institution-wide level and from the "top-down", a circularity analysis can first be conducted at a small scale, and the same approach then applied to other materials, flows and departments. In a sense, conducting a circularity analysis is therefore a "bottom-up" process.

5.1.2 Developing policy "after the fact"

At the beginning of this research process, the research team began with a preconceived notion that in order to conduct a circularity analysis a UBC-wide policy for measuring and analyzing material flows may have to be developed first, or early on in the process. This was primarily based on dominant scholarship on circularity analyses, which discusses the process as being the development of universal indicators, along with recurring suggestions that a comprehensive tool for measuring circularity would be invaluable (e.g. Ellen MacArthur

Foundation, 2020). Conversely, our findings suggest that policy as it relates to capturing the lifespan of materials and material objects, and policy on who decides what happens to them at their end of life, can be developed iteratively. For example, McGill University developed a process for understanding the lifespan of IT assets first, because they viewed these to be the highest risk items in terms of both material and financial waste. Once they tracked and tagged all IT assets, and developed a system for redistributing - internally or externally - at their 'end of life', the university was able to conduct the same process for other items. As they developed an understanding of flows, developed reuse criteria, and decided who was responsible for decision-making in relation to end-of-life items and managing logistics, they were able to develop circularity policies for more items, with a view to using this information to eventually develop a university-wide policy for circularity. Analyses can therefore be conducted for singular objects, types of objects or departments, with some informal guidelines in place to steer this process. Once this process is working well, and has been conducted in a number of departments, a policy can be developed for future measurement and analysis of material flows. This is relevant both for UBC in their journey towards conducting a circularity analysis, and for other organizations and institutions who desire to conduct a circularity analysis. As such, policy can be developed at a later point, based on learnings acquired throughout the process.

5.2 Data

5.2.1 Metrics, indicators and narratives

This research sought to understand what data would be required in order for UBC to undertake a circularity analysis. Metrics and indicators were primarily in mind, as these were the data most commonly referred to by others in the field (e.g. Ellen MacArthur Foundation, 2020;

Rocchi et al, 2021). It was discovered that a large volume of metrics and quantitative data on waste already exist at UBC, but that there can sometimes be barriers to obtaining data. Barriers might include whether, for example, data is held by a third party, as is the case with some recycling data, or if it is hard to access, as is the case with some data which is accessible through Workday[2] . While it might be the case that these data-types are somewhat important for getting the process "off the ground", and that barriers to obtaining data may be a hindrance, qualitative data that can provide a comprehensive picture of who is responsible for items and flows, including how their "end of life" direction is decided and by whom, might be equally if not more important. In order to add nuance to the traditional focus of circularity literature on metrics and indicators, information on the journey of materials and who is involved in managing and making decisions about these materials is just as vital for beginning the process of conducting a circularity analysis . The research findings have provided some indication regarding what types of data will be needed, and what types of data already exist, but this is not comprehensive, and more work may have to be undertaken to ascertain what data UBC needs beyond what is listed below in Table 2. One approach to finding this out could be to recruit the support of UBC academics working on circularity, who may be able to support in the development of a methodology and analysis strategy - which was the approach taken by the province of Quebec. Table 2 indicates the data this research identified as having been useful to external interviewees who had conducted some form of circularity analysis, as well as data which some UBC staff identified as already being available at the institution.

[2] Workday is a software that is used for a range of financial actions at UBC. In relation to data connected to circularity/waste, some reimbursements and procurement activities have their data stored in Workday. Retrieving this has time and labor commitments. Additionally, some data is "stewarded" by individuals and departments at UBC meaning that it is not readily accessible and often requires good relations in order to be accessed by interested parties.

Table 2

Data needed (general material inputs e.g. where do material objects *come from*)	**Data needed** (UBC or departmental level)	**Data which already exists at UBC**
Forestry	What UBC purchases	Some waste metrics*
Agriculture	Who is responsible for purchasing items	Composting
Mining	Who keeps track of UBC's items and how	Staff and student waste-related behavior
Water	Where does *the majority* of waste at UBC go	Staff and student reactions to previous projects
Energy	What items are *most likely* to end up in landfill at UBC	From student housing: data on work with De-brand (clothing); company who shreds their excess linen and pillows; battery recycling; glass recycling
	Who currently decides what happens to an item or item group at their "end of life"	Facilities management data on reuse of tubes

*Some waste metrics are held by departments. Some waste metrics (e.g. recycling) are held by the third party, where the third party is responsible for UBC's waste processing.

5.2.2 Learning by doing

In addition, while beginning the process of conducting a circularity analysis with some data can be useful, having comprehensive data on every aspect of assets and material flows might not be necessary in order to begin the process. Instead, conducting a circularity analysis and implementing circular economy measures can involve a considerable amount of "learning by doing"; that is, not capturing all data before conducting a circularity analysis but instead beginning the process of understanding how materials currently flow through a department, at a small scale, and gathering relevant data along the way. In some cases, the data that is initially useful will become redundant at a later stage in the process. Indicators and metrics might

therefore be a useful analytical tool, but a circularity analysis can begin without them being solidified. While debate continues about *which* metrics are required to conduct circularity analyses in general, our results indicate that data can be collected *during* the process (De Oliveira et al., 2020; Rocchi et al., 2021). As such, while it may be useful to begin the process with some indicators, it is more important to get the process "off the ground" and develop indicators iteratively instead of lamenting over the "right" indicators. A starting point, for example, could be to develop an understanding of where items and materials come from; decide who manages these items; decide who and how they are tracked; select a person to be responsible for tracking and tagging[3] the item and for deciding the future of disused items; creating communication channels for finding new homes for items and; deciding removal logistics. At McGill, after these details were agreed upon and circularity measures were being implemented, the most appropriate indicators and metrics were identified by the people responsible for tracking and redistributing disused or unwanted items. Indicators could also be adapted, if it was discovered that they were no longer useful. For UBC specifically, while data is often gathered prior to the initiation of pilot projects, it may not be necessary to gather an expansive or comprehensive data set ahead of project commencement in the context of circularity analysis. Rather, it may be possible to begin with a rough set of indicators, which can be refined and adapted as the process advances. Additionally, it may be more important to gather the relevant staff members for one item or item group to establish roles and responsibilities, and criteria for reuse. Once the process of implementing circularity measures is underway, it will likely become easier to identify what the relevant indicators and metrics should be for any given item or item group.

[3] At McGill University, understanding flow of materials was done, in part, by tracking down all items belonging to an item group (IT equipment), tagging them, and assigning responsibility for them to a person/person. Tracking and tagging all items meant that the Sustainability Officer could collect data on what IT equipment existed, who had it, what condition it was in and, when it was not wanted or in use, a decision could be taken about where it would go next, based on a set of criteria that were developed at the beginning of the process and adapted throughout.

5.3 Towards a shared understanding of "circularity"

While establishing what data might be required and to what extent data is valuable for beginning a circularity analysis is fundamental, it is perhaps more important for all relevant actors to begin with a shared understanding of what circularity is and the purpose of identified projects. In order to do so, it is critical that stakeholders involved in undertaking a circularity analysis, whether at a small or large scale, agree on a common narrative or understanding of exactly what is meant by "circularity". As one external participant highlighted:

"…it's not set in stone which is great in a way because, you know, you can develop anything and you can adapt it to your to your needs, but the offset is that for instance, when we were analyzing them we were putting a number of how many of the outputs were being looped. Some people were saying energy recovery is a form of a loop. So there was not clear boundaries on not clear definitions on some indicators that we proposed" - Respondent 8 (Researcher, Quebec College)

Therefore, forming a common definition should include close consideration of what does and does not count as reuse, as well as what items and materials will be included in the common definition of circularity.

Further, as Niero et al. (2019) and Rocchi et al. (2021) have both emphasized, it has been challenging thus far to agree upon how to conduct a circularity analysis and how to implement circularity measures. This step is a vital component for conducting a circularity analysis at UBC, and should take place early on in the process, with scope to review the definition as the project progresses.

5.4 Resources: People, money and time

Another precursor to conducting a circularity analysis which precedes the need for metrics and indicators, is the securing of required resources - namely money, time, and human

resource capacity. In many cases, circularity-related work is currently done "on the side" of a university employee's other work, which makes the prospect of undertaking additional work daunting and potentially unrealistic. Beyond the need for at least one additional staff member or team to be working on a circularity analysis in order for it to be successful, the involvement of other departments, faculty and teams, university leadership, and at times students can also act as a facilitator to a successful circularity analysis. Additionally, a circularity analysis and implementing circular economy measures is a considerable time commitment, with some analyses taking over 6 months to complete (and possibly more depending on the scope and context). This latter point confirms the need to have people and money dedicated to the process of conducting a circularity analysis and as Niero et al. (2019) point out, these will likely be somewhat context specific. The successful cases we examined typically had 1-4 people working on the project in varying capacities, ranging from full-time to part-time support, for several months, as well as a steering committee. Plans for larger analyses typically had dedicated teams with timelines of several years. In almost all external and internal interviews, participants indicated that circularity required additional funding and at least one, if not more, dedicated project manager to sustain the project - all of which would be made more possible through buy-in from senior leadership. Evidently, there are many more practical elements necessary for conducting a circularity analysis than just metrics or indicators alone, and in the context of UBC, adequately resourcing a circularity analysis will be a central determinant of the success and longevity of this project. Future research may wish to consider in greater detail what resources are valuable and necessary to the process of conducting a circularity analysis.

5.5 Engagement and buy-in

In addition to securing resources, engaging with the student population and securing the sustained engagement and backing of senior management were also identified throughout our study as being central features of a successful circularity analysis. Again, this is outside the realm of metric and indicator driven approaches that have been the dominant focus for organizations working on the development of circularity analysis tools, like the Ellen MacArthur Foundation (2020). Our findings indicate that beyond defining a set of relevant data points ahead of and during the circularity analysis process, those involved will need to implement a range of persuasive, co-ordinated, and sustained communication strategies in order to ensure that students are supportive and responsive to any new circularity measures being implemented. In addition, convincing senior management at UBC of the need for conducting a circularity analysis will be vital in helping to secure the much-needed financial resources, especially additional staff, and the time commitment required to conduct a circularity analysis. As one external participant noted:

"...there was a barrier in terms of the support from the high level. It's not that sustainable development or environment is not viewed as important, I think everyone is okay with the principle. It's really in terms of that there's a lot of administrative challenges right now at the college, and just at the, they have to concentrate on how to manage the college. And so in that context, sustainable development is seen as something that is not necessary, or we'll do that later once we're more settled. Even though it appears in some strategic plans, or when we discuss with the administration , they say it is important, like, we see that something is always being pushed. So without…dedicated people, like a Sustainable Development office or person whose job it is to do that kind of analysis, and it is mandated, I think it's really hard to work around that." - Respondent 8 (Researcher, Quebec College)

One way of doing this may be to explicate, based on findings from this report, the university's ability to meet its own goals as laid out in their Zero Waste Action Plan (University of British Columbia, 2014), the overall reputation of the university as a leader in sustainability

initiatives, and the potential for a circularity analysis to have a positive impact on the long-term financial costs to the university.

Further, it may be beneficial to foster student engagement in the early stages of a circularity analysis as a means to procure increased support from senior leadership. Participants discussed the potential of student support to influence leadership decisions. In UBC's student accommodation, work has already been undertaken to educate students on sustainable options for unwanted items at the end of their stay in student accommodation, and those seeking to implement circularity measures at UBC should seek to learn from and build upon this approach, in order to ensure students are on board with the development and implementation of circularity measures. Student support can also be engaged to participate in the process of conducting a circularity analysis. One institution engaged students in the process of gathering data relating to items and item groups where a circularity analysis was being conducted and circularity measures implemented. Broad student support, in the form of political will, as well as practical support, will be a key factor in ensuring the required resources for conducting a successful circularity analysis. Lastly, it is important that staff are aware of what is happening, and why, in relation to the analysis and management of material flows at UBC so that they can support procedures where needed, such as providing access to data that they preside over.

6.0 Recommendations

From the research conducted we have a number of recommendations to put forth. These primarily relate to governance, resourcing, data and indicators of a circularity analysis.

1. **Create a circularity analysis committee**

The central recommendation is to create a committee with the purpose of undertaking a circularity analysis at UBC. It should involve stakeholders from procurement and waste management roles, student reps, and faculty from both scientific and social scientific backgrounds. The committee should play a central role in ascertaining how much staff resource and budget should be committed to the analysis.

2. **Create *at least* one project lead/officer position**

We recommend that UBC create at least one new staff position, and associated budget for this role (e.g. Circularity Analysis Project Manager/Officer). Creating a new position to manage the circularity analysis will require adequate time and funding to support the success of the circularity analysis. An external interviewee stated that their successful analyses typically included 1-4 dedicated staff working on the project for several months, and we assume that a similar model would support success at UBC. Our findings suggest that creating multiple positions would further increase the likelihood of successful circularity analyses, although more research is needed on how many staff members are needed, and the related budget. These staff members would be responsible for undertaking tasks including coordinating stakeholders and departments, developing a robust communications strategy, project management, life-cycle analyses, and the development of a strong relationship with senior management in order to secure the future needs of the project.

UBC has a strong research focus amongst its faculty, and internal interviews showed a desire to utilize this to support circularity analyses and initiatives. Further exploration on how best to include faculty in circularity analyses at UBC should be conducted.

3. **Create a UBC-specific definition of circularity and circularity analysis**

As a starting point, it will be vital that this committee creates a context-specific definition of circularity that will be used for the circularity analysis. One approach to doing this could be in a workshop setting, and by involving academics who work on circular economy. Once a definition is developed, we recommend identifying a specific material(s) or department to pilot a circularity analysis. After conducting a pilot, it may be worthwhile to review the initial common definition of circularity.

4. **Gather baseline data and develop indicators for measuring circularity**

It will be useful to collect internal baseline data to determine the starting point for UBC, as well as the most impactful areas of opportunity for improvement. To do this, UBC should identify all individuals who interact with the flow of the material(s) identified for pilot projects and interview them to find out what their responsibilities are in relation to the material, the disposal of the material, and the potential for reuse of the material. Concurrently, the committee should develop indicators for measuring the circularity of these specific cases or items. These indicators should be continuously reviewed, and iteratively adapted as their efficacy becomes apparent through a process of ongoing data collection. **Table 2** provides a starting point regarding what data will be useful to UBC, but further research could identify additional data sources that will be useful beyond this.

5. **Develop a formal engagement strategy for staff, students, and university leadership**

We recommend that the committee and/or Circularity Project Manager develop a formal strategy to engage students and university leadership in order to garner broad support for future

circularity practices on campus. Ensuring the widespread support of students will help to ensure that any new circularity measures are understood and supported. Generating an enhanced awareness of the benefits of circularity measures may also serve as a useful tool for holding the institution accountable. Gaining the support of university leadership will be an important way of maintaining the resources necessary for the success of a circularity analysis. Further study is required on how best to garner this support, but promoting current circularity initiatives is a promising starting point. Doing so may foster broader engagement and support of circularity amongst members of the UBC Community.

7.0 Conclusion

In this report, we explored best practices from various institutions with the aim of supporting UBC in the development of a circularity analysis. We found that, although the concepts of circular economy (CE) and circularity have gained momentum in the past few years, existing literature rarely addresses the indicators needed to develop a circularity analysis and, when it does, findings are still highly contextual.

For this reason, we proceeded by analyzing circularity strategies developed by different institutions, both universities and jurisdictions, and then focused on the UBC context in order to assess what best practices might apply to our institution.

Contrary to our expectations, this research did not find one clear vision of what a successful circularity analysis looks like. Rather, there are a number of facets that can help post-secondary institutions conduct circularity analyses.

Our main finding was that, being the context under consideration highly significant, it is possible to conduct a circularity analysis starting on a small scale, and then develop a circularity framework. Specific policy can be formulated at a later time, in an iterative manner. More specifically, successful pilot projects conducted in one sector or department could potentially be scaled up and applied to other settings. Piloting may allow UBC to progressively gather and analyze data throughout the process, adopting a "learning by doing" approach. In terms of data, we concluded that it is not necessary to collect all data prior to the analysis. Instead, it might be more useful to agree on some common indicators that can be then revised if necessary. As reported in the literature, indicators can be adopted to measure circularity for a variety of sectors, such as pilot projects on individual assets, groups of assets (material flows), or flows such as waste, energy, and water . Just like other institutions, UBC has already implemented some pilot projects that might represent a good starting point for data collection.

Nonetheless, before the identification of indicators to measure circularity, external stakeholders have indicated the importance of adopting a common definition of the concept. Ensuring a shared understanding of circularity was identified as an important baseline which is especially useful in the first stages of conducting a circularity analysis.

In terms of data collection, some major obstacles exist at UBC, especially when it comes to its accessibility, since data is often held by a third party and thus difficult to obtain. From external stakeholders, we found that the usefulness of quantitative indicators had previously been overestimated in the literature for the development of circularity analyses. Although still relevant, merely focusing on quantitative data could result in inadequate understanding of crucial dynamics unfolding at UBC, which may be more thoroughly understood through a qualitative approach. More specifically, qualitative data on who is responsible for data collection might

provide significant insights on major stakeholders involved in circularity-related tasks and the role they play at UBC, thus producing a more comprehensive picture of the context examined. When considering quantitative components, it is impactful to utilize an iterative process, with learnings re-integrated into the project and future initiatives. It appears to be preferable to begin the process with imperfect metrics/indicators and to adapt as needed, rather than lament over what the perfect indicators may be without beginning the analysis.

As suggested by all external stakeholders, resources play a critical role as facilitators of success. In particular, committing money, time, and human resources can prove vital to sustain the effort towards circularity.

Lastly, it is important to ensure strong channels of communication and awareness-raising exist among all relevant stakeholders, including students and faculty, and to secure support from senior management for the principles that underpin the need to do a circularity analysis in the first place.

The recommendations provided should be followed as guidelines to develop a circularity analysis at UBC. Nonetheless, it is important to keep in mind that the process of developing circularity is not a linear one, and as such it requires continuous revision and re-elaboration of practices, together with great flexibility of all stakeholders involved.

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