# Scale Up *This?*

# Improving Scalability and Viability in Upcycling Design

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A Thesis in the Department of Design and Computational Arts

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Design at
Concordia University
Montréal, Québec, Canada

August 2023

CONCORDIA UNIVERSITY
School of Graduate Studies

This is to certify that the thesis prepared

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Entitled: Scale Up This? Improving Scalability and Viability in Upcycling Design

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Master of Design

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# Abstract

## Scale Up *This?*
## Improving Scalability and Viability in Upcycling Design

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The circular economy (CE) has been hailed as a model for material recirculation, but waste management remains the dominant method of material recovery. Upcycling offers a transitional approach to the CE, reusing waste in ways which increase its value using current recovery systems. However, craft production methods common to the repurposing approach of most upcycling enterprises hinder their ability to scale up. This thesis aims to assist designers in these challenges by informing and improving operational scalability and business viability in upcycling design.

Despite its multifold benefits, upcycling practices remain niche. Research on the topic is scattered, and very few publications offer detailed practical guidelines for designers, particularly in furniture and object design, a priority sector for circular initiatives given its heavy waste volumes.

To bridge these gaps, this research-creation project employs practice-based, primary and secondary source methods. The author's design practice in developing a collection of upcycled furniture and objects serves as a real-world example — from material sourcing to design, prototyping and exhibition. This project is later considered in light of two upcycling enterprise case studies as well as a comparative analysis of 20 upcycled furniture and object projects across four categories.

This research confirms the challenges of scaling up while identifying numerous practices which can help. These contribute to a proposed strategic design process for upcycling, from material sourcing through to design development. This practical framework aims to support designers and others in creating scalable, viable upcycling projects and enterprises, thus contributing to increased material circularity.

**Key Words**

Upcycling
Repurposing
Design from waste
Circular entrepreneurship
Circular economy business models
Circular design
Designer-makers
Sustainable craft
Furniture design
Design processes

# Acknowledgements

A tip of the hat to:

Martin Racine, who convinced me to do this master at Concordia, who has supervised my research, and helped me maintain a focus on scaling up throughout this research.

Alice Jarry, research committee member and professor of a memorable class called Critical Materiality, whose enthusiasm is ever contagious and advice is ever on point.

Isabel Ordóñez, Barcelona-based research committee member, who, beyond her research cited in this paper, has contributed a wonderful array of insights on upcycling practices and material reuse centres in Europe.

Hanna Jörlén, a Gothenburg-based architecture researcher, whose thesis and design process have been an important source of inspiration for my design process.

Concordia's workshop technicians Brian Cooper, Mauricio Aristizabal, Tom Simpkins, Elizabeth Xu, Chris Latchem, and Karolyn Martin – you have enabled me to expand my skill set in so many ways.

Ata Saeed, Marc Pearce and Francis Bertrand for their amazing production assistance in the run-up to the exhibition. And to my family in general, whose lineage in thrift and upcycling is genetically hardwired and manifests itself in all kinds of wonderful ways.

# Table of Contents

# Figures (excluding photos)



# Tables

# Section 1 Introduction

## Problem Area

Upcycling has seen a huge rise in popularity since the financial crisis of 2008-2009 with blog posts and then social media fueling the buzz on upcycling-related projects. As of the time of writing, a search on Instagram results in some 6.2M posts for #upcycle and the online craft marketplace Etsy lists over 482,000 upcycled items offered for sale. Global fast-fashion and luxury brands have started following the lead of numerous smaller designers in reusing clothing and fabric offcuts. From architecture to furniture to food, companies in all kinds of areas are jumping on the upcycling bandwagon. In low to middle income economies, informal sector-led recycling and upcycling is not so much trendy as it is an intrinsic part of environmental and economic systems, with waste pickers involving by one estimate up to 2% of the population of some countries (Medina, 2000) and playing a key role in diverting waste from landfill towards reuse and recycling markets (Dias, 2016).

The term "upcycling" has multiple definitions and interpretations across academic literature, business, and popular usage. This ambiguity may well stem from the diverse range of upcycling practices, from individuals to creative entrepreneurs, SMEs and entire industries (Singh et al, 2019). Yet there is a general consensus that upcycling involves taking waste materials and increasing their value without the need for additional processing that recycling requires. Upcycling aligns with circular economy design and business model approaches, and has been found to generate multiple environmental, economic and social benefits (Sung, 2015).

Despite all the buzz and benefits, upcycling remains a niche phenomenon in developed countries with barriers for both small-scale and industrial upcycling practices (Sung, 2017). While some professional designer-makers, design studios, and small manufacturers have successfully used upcycling approaches, few have achieved significant scale. Scaling up upcycling can potentially enable designers like me (a furniture and object designer) to work meaningful and viably within a circular design perspective.

The problem of scaling up upcycling  is vast, encompassing issues of waste management, material sourcing, craft production methods, material constraints, communication and distribution channels, competitiveness, and consumer purchase drivers. While recent research has started addressing these interconnected questions, most studies focus on case studies of design and production processes, and lack in-depth insights into material sourcing, business operations, and scalability. However,

the architecture and building sectors, with their higher material and financial stakes, have seen the emergence of frameworks for upcycling building materials in design (de Castro Pereira, 2017; Gorgolewski, 2017; Jörlén, 2020).

As the written component of a master of design capstone research-creation project, this thesis aims to fill the knowledge gaps in scaling up upcycling enterprises from a designer-maker, material and production scalability, and business viability perspective. The chapters to come present a theoretical framework addressing these areas, the results of my own design practice in sourcing material and creating a collection of upcycled furniture and objects, two case studies on furniture and object upcycling enterprises, and a comparative analysis of 20 upcycled furniture and object projects — all feeding into a proposed strategic process to improve the design and business planning of upcycled objects. With these contributions, I hope to encourage the creation and scaling up of viable upcycling projects and enterprises.

Visual culture and art history researcher Gillian Whiteley points out that waste is a social and cultural construct, and that the word “trash”, “like its physical manifestation, is in a continuing shifting state of conceptual, political and material flux” (Whitely, 2011, as cited in Lange-Berndt, 2015, p. 109). If the circular economy is out to turn trash into sustainable treasure, upcycling offers one path to help us get there, one that can be as wildly creative as it is wickedly challenging. Onwards with this thesis.

# Research Purpose and Focus

## Research Aims

Upcycling-related practices has been identified as a circular design approach and a circular business model with many benefits. Given the immense system challenges of implementing the circular economy, upcycling offers a transitional approach, which works with existing material recovery systems. Yet upcycling practices remain niche and small scale, and research on the topic is fragmented (Paras & Curteza, 2018; J. Singh et al., 2019).

The purpose of this research is to contribute to knowledge relating to circular design , circular production processes, and circular business models in general; and to upcycled design processes, and the scaling up of upcycling enterprises in particular. Through this project, I hope to encourage the creation of viable upcycling design projects and enterprises. This research is aimed at business-oriented designer-makers and design entrepreneurs, as well as designers involved in upcycling projects within studios or manufacturers. While the focus is on furniture and object design, the findings may also be of interest to other areas of design, such as fashion, building materials, and so on.

## Research question

*How can upcycling-oriented furniture and object designers improve their design process, from sourcing materials to production, in order to help scale up their operations and increase material circularity?*

### Sub-question

*What practices can help upcycling-oriented furniture and object designers arrive at a viable enterprise?*

# Research Methods Overview

Research methods used in this project include a review of theoretical foundations in relevant literature, as well as two case studies and a comparative analysis related to furniture and object upcycling. As a research-creation project in design, the project is also based on the researcher's upcycling practice, namely the material and sourcing research, design, development and exhibition of a collection of upcycled furniture and objects.

Based on this theoretical, desk-based, and practice-based body of work, this research proposes a process model for the design and development of upcycled objects.

# Research Limitations

### Upcycling Using Repurposing (Creative Reuse)

The design practice, case studies and design review components of this research-creation project are focused on repurposing (also known as creative reuse) as opposed to other interpretations of upcycling and reuse, such as refurbishment, remanufacturing, and certain forms of recycling (see definitions in glossary section).

### Furniture and Objects

This research is focused primarily on the upcycling of furniture as well as interior design objects and accessories, and thus involves processes which are somewhat different from other application areas of upcycling, such as fashion, electronics, architecture and building materials, urban design, and so on.

### Professional Designer-Maker/Small Enterprise Perspective

This research is primarily focussed on professional designer-makers and design entrepreneurs, as well as design-driven micro and small enterprises. It is thus interested in design processes, craft production, and micro to medium scales of operations.

# Glossary

## Upcycling (Theoretical Definition)

For the purposes of the theoretical framework that follows this section, the term upcycling is used broadly, embracing the concepts of reuse, repurposing, refurbishing, repair, and remanufacturing, as well as recycling when its context suggests reuse rather than (or in addition to) downcycling. Thus the broad scope of this definition:

*"A process in which products and materials that are no longer in use, or are about to be disposed, are instead repurposed, repaired, upgraded and remanufactured in a way that increases their value"* (J. Singh et al., 2019).

## Upcycling (Practical Definition)
## Repurposing
## Creative Reuse

If you ask a designer-maker to define upcycling, they are likely to define it in the sense of repurposing, also known as creative reuse. Repurposing has been defined as follows: *"The use of a product or material for a different function than it was originally produced for"* (World Business Council for Sustainable Development, 2018).

This definition is helpful, however, the material may be already broken down from the start, and the idea of increase in value is not clearly specified. My definition is thus:

*The use of "waste" objects or material, whose original form and structure are still recognizable, for a different function than what they were originally produced for, while maintaining this recognizability and increasing value in the resulting new object or material.*

This definition of upcycling will be the one used in the desk research and practice-based design projects sections of this thesis unless otherwise specified. "Repurposing" or "Upcycling through repurposing" will also be used for clarity.

## Recycling

This is my definition combining elements from three sources:
*The process of collecting and sorting products, components or materials from waste streams, reducing to their most basic or raw form and reprocessing them for use in another manufacturing process or other purposes.* (Ellen MacArthur Foundation, 2020; European Environment Agency, 2017; "Recycling," 2021).

In this thesis, recycling refers to the above definition, unless it is explained as also embracing reuse and upcycling, as some publications still do.

### Downcycling

*Recycling processes which result in materials of lower quality and reduced functionality* (Ellen MacArthur Foundation, 2014) *or an application of lower value than the original* (Allwood, 2014, as cited in Zhang et al., 2020).

### Reuse and Direct Reuse

Most authors employ a broad definition of reuse, which thus includes the possibility of upcycling. This is the definition I will use more generally when writing about reuse: *"Using a product or material again, either for the same or an alternative function"* (World Business Council for Sustainable Development, 2018).

The EU's legislative definition is much more restrictive: *"Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived"* (Waste Framework Directive, 2008, art. 3, para. 13). When referring to this narrower definition, I will refer to it as "direct reuse".

### Refurbishing

Refurbishing generally means to make something look new again, but the definition and the activities involved vary depending on the context. Here's a definition related to products: *"Return a product to good working order. This can include repairing or replacing components, updating specifications, and improving cosmetic appearance*"

In the case of furniture, this can mean *"reupholstering, refinishing, adding a different top or seat, repainting or staining, or a complete overhaul"* (Spangler, 2018 para. 2)

### Remanufacturing

*Reprocessing a used product to give it a level of functionality and form equivalent to when that product was new*. Remanufacturing sometimes includes the correction of design flaws or adding functional or aesthetic enhancements (Krystofik et al., 2018).

Note that the definitions of upcycling will be discussed further in the theoretical framework that follows.

# Section 2
# Theoretical Framework

## Defining Upcycling

To contribute to the scaling up of upcycling practices, it is important to understand where the upcycling concept came from, sort through its various interpretations, and understand how upcycling creates value.

### Evolution of an Instinct

Upcycling is a natural instinct with a long and storied history, from tools of the Neolithic era (Kuijpers, 2019), to architecture and construction material reuse, which was common up until the 20th century (Stockhammer & Koralek, 2020). Scavenging, recycling and reuse have been documented since at least since eighteenth century in the West (Mayhew, 1968, as cited in Blincow, 1986; Strasser, 2000), while these activities continue to be integral to the economies of low to middle income countries (Dias, 2016; Medina, 2000).

World War II manufacturing led to intense metal salvage campaigns on both sides (Denton & Weber, 2022) while citizens were encouraged to repurpose household items (Jencks and Silver, 1973, as cited by Lee, 2019). These campaigns led counter-culture movements of the 1960s and early 70s to rekindle the spirit of recycling and reuse as part of a growing ecological awareness in the face of unabated development and consumerism. As counter-culture researcher Castillo (2018) notes, “Hippie builders viewed waste as both a repressed material artifact of ecological degradation and, conversely, an underappreciated resource with which to create alternatives to postwar affluenza” (p. 306). Although the term did not yet exist, it was the beginning of upcycling’s recognition as a sustainable practice. For more of upcycling’s backstory, see *Appendix A: A Brief History of Upcycling*.

### Origin of the Term and First Definition

The first published use of the term upcycling comes from a 1994 magazine interview with German engineer Reiner Pilz on the future of Europe: ““Recycling”, he said, I call it down-cycling. They smash bricks, they smash everything. What we need is upcycling, where old products are given more value, not less.” (Kay, 1994, as cited by Stockhammer & Koralek, 2020). This idea, conceived in opposition to recycling, has

been expanded upon through many papers, such as the upcycling literature review conducted by Kyungeun Sung (2015), who notes that upcycling is often defined on the basis of the seminal circular economy-related book *Cradle-to-Cradle* (McDonough & Braungart, 2002) as a "process to maintain or upgrade materials' value and/or quality in their second life and beyond" (Sung, 2015, p. 30).

## Multiple Interpretations

After reviewing a wide range of definitions, Sung groups the varied conceptions of upcycling into an amalgamated definition:

> the (re)creation of new products (artistic, scientific or useful) with higher values and/or qualities and a more sustainable nature by converting, turning, transforming, or repurposing waste or used material/product, by reusing an object in a new way without degrading the material, or by remanufacturing, giving it another new life while reducing unnecessary resource expenditure. (Sung, 2015, p. 30)

In this multifaceted definition, we find both the richness and the ambiguity of the upcycling concept. In terms of richness, there is the wide range of possible applications, the idea of increased value in the economic sense but also in terms of quality of what's produced, and the sustainability benefits that this activity entails, through reduced resource use or otherwise.

The ambiguity comes from the inclusion of both products and materials as waste inputs. This opens up the possibility that upcycling can start from materials that have already been broken down into waste material, such as shredded textiles or Reiner's example of crushed bricks. So in this case, are we talking about upcycling or recycling? Nineteen of the 55 publications surveyed by Sung suggest that the results of upcycling can be either products or materials, which in the case of materials tends to suggest recycling used to create intermediate use products, like building materials. Given such ambiguity, Sung wonders whether industrial usage of the term upcycling should include qualifiers, e.g. "industrial upcycling based on recycling" vs. "industrial upcycling based on remanufacturing" (Sung, 2015, p. 33) .

The trendy and upbeat feel of term upcycling makes it a handy catchphrase in academic research and the business world alike for embracing all of the above-mentioned activities, which are all seen as important in terms of their contributions to sustainability. However, the lack of a single clear meaning may explain why the term upcycling is often absent from government circular economy (CE) policy texts. Instead, we see terms such as recycling, reuse and remanufacturing defined in strict terms (European Environment Agency, 2017; Government of Canada, 2021; Waste Framework Directive, 2008).

## Upcycling Through Repurposing (Creative Reuse)

Repurposing is upcycling in the spirit of Reiner's definition, which is opposed to downcycling, and not simply about remanufacturing a product to its original level of performance, nor is it about repairing or refurbishing something like a piece of furniture in a creative way. I see upcycling through repurposing impling four conditions:

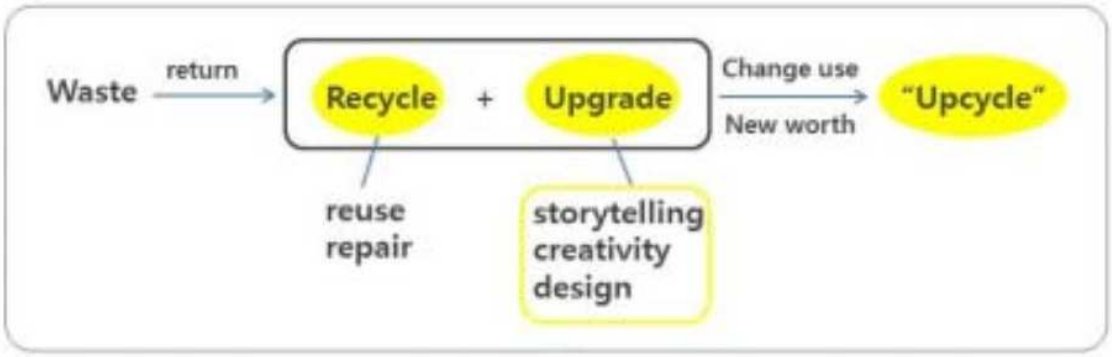
1. **Recognizable at the start:** start from an object or material that is considered as waste and is still recognizable in its form and structure, i.e.: it may or may not be broken, but it's not already downcycled or reduced to bits and pieces.
2. **New purpose:** leverage an object's structural and formal properties in a new object and or use context, i.e.: repair, refurbishing or remanufacturing are insufficient, even though these processes may also be used as part of a creative reuse project resulting in something new.
3. **Recognizable at the outcome:** maintain enough of its form and structure in the upcycling process so that its origins are still recognizable in the resulting object
4. **Value increase:** increase the value of the object or material in the process through design/creativity value, sustainable value, ethical value or storytelling value.

For the purposes of the design practice and desk research components of this research-creation project, upcycling is defined more strictly in this sense of repurposing or creative reuse. For the remainder of the theoretical review, upcycling is defined in the broader sense unless otherwise specified.

## Value Creation in Upcycling

In their study of upcycling in furniture design, scholars from the Hongik University's Department of Woodworking and Craft Design in Korea suggest that the upcycling process involves "upgrade" elements of design, creativity and storytelling, and the resulting artifacts go beyond simple reuse to become "reborn" with additional functional or aesthetic values (Baik & Kim, 2014) (Fig. 1).

**Figure 1:** ***Upcycling Process Overview Identifying Sources of Value Creation***

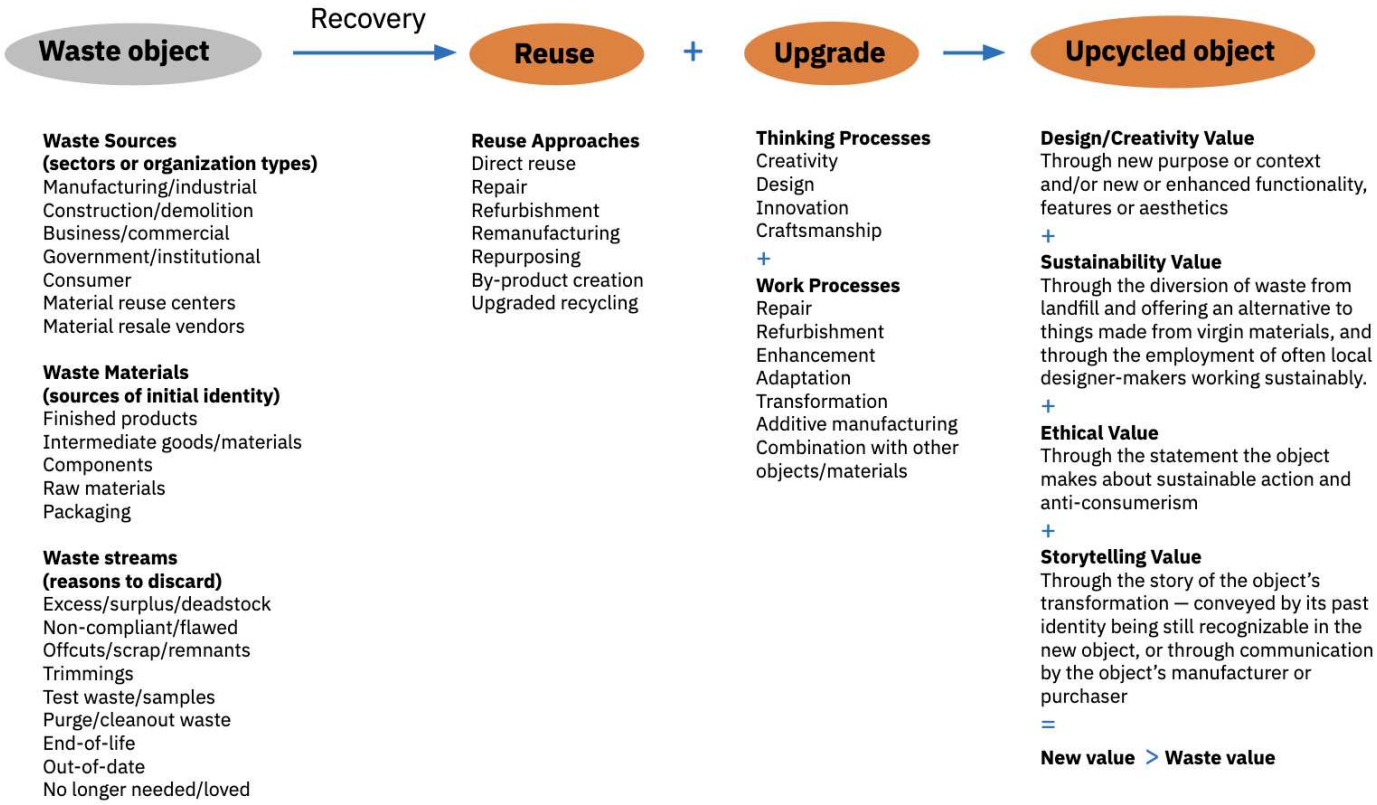



*Note*. "Upcycling Concept" (Figure) in "A Study on the Trend Analysis of Upcycling Furniture Design" by Eun Baik and Ja-hyung Kim, 2014, *Journal of Korea Furniture Society*, *25* (2), p. 112. https://koreascience.kr/article/JAKO201414937714821.page

Baik and Kim's idea of "upgrade" relates to value creation. Upcycling offers the possibility of creating value on several levels, especially when it is based on repurposing. Analyzing the semiotics of value creation at work in upcycling, Swedish researchers also identify gains in economic, aesthetic and functional value, but also ethical value, in the sense of messages of sustainability and anti-consumerism (Archer & Björkvall, 2017). Building on Baik and Kim's schematic with these Swedish findings, the following expanded schematic presents the upcycling value creation process in terms of waste sources, approaches, processes, and various forms of value, which amount to something greater than the initial value of the waste (Fig. 2).

**Defining Upcycling**

**Figure 2:** ***How Value is Created in the Upcycling Process***




*Note*. Author's elaboration based on "Upcycling Concept" (Figure) in "A Study on the Trend Analysis of Upcycling Furniture Design" by Eun Baik and Ja-hyung Kim, 2014, *Journal of Korea Furniture Society*, *25* (2), p. 112. https://koreascience.kr/article/JAKO201414937714821.page

This expanded schematic illustrates how thinking and work efforts can translate into various forms of increased value in the resulting object, depending on the reuse approach and the level of upgrading involved. With creative reuse, the idea of giving the object a new purpose is a form of value in itself, which relates to creativity, innovation and design thinking. Form and functionality are very tangible expressions of value, and all of this 'newness' can be labeled "design/creativity value." Sustainable value is inherent to reusing waste, but also to purchasing from local craftspeople, and this translates into ethical value on a social and societal level. Friends may view your announcement of a new purchase as a wasteful desire for novelty, but when you inform them that the piece is upcycled, your act of consumption is suddenly redeemed, and even becomes an example for them to follow. In regards to storytelling value, the next section explains the process.

## Storytelling and Past Identity Salience

One of the key characteristics of upcycled objects is storytelling. When the previous incarnation of the object is discernible, the object conveys its story of transformation in a process researchers refer to as "past identity salience." Perceiving this transformation in the object turns it into a character of a story, and when a person is able to read the story, they feel special and more engaged with it than with an ordinary new product (Kamleitner et al., 2019).

When the former purpose of the object (or its constituent parts) is difficult to discern, this storytelling is not inherent and instead relies on communications, be it through the manufacturer's or retailer's website, product packaging, and eventually the object's purchaser telling the story to their friends. While having to resort to communications may take away some of the 'ah-ha' power of perceiving the transformation on one's own, our imagination never-the-less takes part in the storytelling. As scenographer and interior designer Gargouri interprets this participative process, the upcycled object takes on in our mind a form of resistance against cultural uniformity (2019).

Past identity salience (or recognizability) is one of the key points of difference between upcycling and recycling. With an object made from recycled materials, salience is typically low, and often non-existent, and so your imagination is less involved in the transformation story. While a recycling story can also be told through communications, the story is rarely as original or as captivating as that of an upcycled object.

Similarly, upcycling that is based simply on repair or remanufacturing do not add value in the same way that repurposing does. Refurbishing can sometimes be done in very surprising ways, with creativity and even innovative functionality coming into play, potentially signaling an ethical element in the idea of reusing something old, and possibly giving the piece a certain storytelling quality. However, a refurbished chair remains a chair, so the idea of previous identity doesn't come into play, and so the object's story is not as compelling.

The concept of previous identity salience will be revisited in the section on perceptions of upcycling, in the review of design-driven furniture and object upcycling, and in the assessment of upcycling design prototypes created as part of the practical research-creation phase of this project.

## Defining Upcycling: Takeaways

- → Upcycling is a natural instinct that has been going on since at least the neolithic era. With anticonsumerist counterculture movements of the 60s, it became an ideology.
- → Since the term upcycling was first recorded in 1994, there have multiple interpretations and uses of the term in academic research, many of which include recycling and remanufacturing.
- → Repurposing, also known as creative reuse, is upcycling in the original spirit of the term, involving repurposing an object or material to create a new object, maintaining some recognizability of the original piece, and increasing value in the process.
- → Upcycling can result in value creation through the upcycled object's design/creativity, sustainability, ethical or storytelling qualities.
- → When an upcycled object's previous identity is recognizable, we can "read" its story of transformation, stimulating our imagination and making us feel a stronger connection with the object
- → The perceived value from an object upcycled via repurposing is typically higher than that of other forms of upcycling, as the transformation is more visible, and so the perceived design/creativity value and storytelling value are higher.

# Upcycling and the Circular Economy

The circular economy (CE) is the primary theoretical framework for upcycling, which is often referred to in CE-related publications by more easily definable related terms of reuse, repair, refurbishing and remanufacturing. This sub-section clarifies upcycling's contribution to the CE and the transitional phase of its implementation.

## The Circular Economy and How Upcycling Fits In

The CE has generated much attention worldwide as a proposed alternative to the "take-make- waste" nature of the linear economy and a solution to reconcile economic growth and environmental sustainability. The often-cited Ellen MacArthur Foundation describes the CE as based on three principles:

1- Designing out waste and pollution
2- Keeping products and materials in use
3- Regenerating natural systems

The foundation suggests that the CE requires system-level changes, which involve "everyone and everything: businesses, governments, and individuals; our cities, our products, and our jobs (Ellen MacArthur Foundation, 2017).

Upcycling fits with the first and second principles as a design strategy and as business models. As a circular design strategy, upcycling can be categorized as "design for reducing material/resource use" (Moreno et al., 2016). In effect, by making use of waste materials, upcycling reduces the use of virgin materials. This strategy could also be identified as "circular sourcing," (Smith-Gillespie, 2017).

In their 2016 analysis of CE business model strategies, Bocken and Bakker, the researchers suggest that the reuse actor is ideally the original manufacturer, who takes back their product and either slows loops by repairing, refurbishing or remanufacturing it; or closes loops by reusing components or recycling materials from end-of-life products and integrates these in its production.

However, the reuse actor can also be a third party, referred to by Bakker as a "gap exploiter," who takes advantage of residual value of the product or waste material and uses it as an input to whatever they are producing (Bakker, 2014; as cited in Bocken et al., 2016). Their output could be an end-use product, such as the same product as the original manufacturer through repair, refurbishment or remanufacturing, or a completely different product through repurposing. The output could also be an intermediate use product, which are used to make end-use products, such as construction materials. Intermediate use products are often made through recycling processes.

## Circular Economy Implementation Challenges

To date, circular economy legislation in the EU has essentially resulted in non-binding measures that rely on self-regulation and voluntary implementation, thereby undermining CE's potential for real transformation (Nogueira, 2022). In Canada, CE legislation has been found to be more limited than in the EU (Cocker & Graham, 2020), while the United States is even more of a laggard; its much-touted 2022 carbon reduction legislation package known as the "Inflation Reduction Act" doesn't even mention the circular economy (Berry et al., 2022; Tett, 2023).

Beyond legislation, the challenges to CE are formidably systemic and complex. These include the development of reliable waste-flows to serve as inputs, integration of data on the true value of materials to drive decision-making, and stakeholder collaboration across industries and geographies to bring about system-wide changes, including how we interact and transact with our world, consume things, and relate to so-called waste. These types of paradigm shifts are prerequisites to the disruptive business models required to drive the transition to a truly circular economy (Ehrlichman et al., 2018; Geisendorf and Pietrulla, 2018; Kuhn, 1996; as cited by S. Singh et al., 2021).

Singh& Ordoñez point out that CE's focus is to reduce waste at the product and system design level, while current linear economy the model for material recovery is waste management, which is largely post-consumer driven and local, and entails many end-of-life uncertainties for products put into the system (2016).

## Upcycling as a Transition Strategy

With multiple stumbling blocks to systemic reuse, upcycling-related activities remain niche, yet are happening today in a wide variety of micro and small enterprises. In their paper on resource recirculation, Singh and Ordoñez (2016) analyze 57 examples of upcycling and other forms of post-consumer resource reuse, and find an increase in value between the original material or product at the end of its life and the resulting product, suggesting that upcycling offers an effective transition strategy for the resource recovery systems of the current linear economy.

Upcycling enterprises are a form of circular entrepreneurship. Researchers have found that small and medium enterprises, and circular entrepreneurs in particular, have a significant role to play in the CE, with both startups that are born circular, and existing businesses that transition to circular practices (Gennari, 2022; Prieto-Sandoval et al., 2019; Suchek et al., 2022).

## Upcycling Benefits

Upcycling's environmental, economic and social benefits are numerous. Sung's literature review on the topic (2015) details a broad range of them:

### Environmental Benefits

- → Reductions in environmental impact or higher environmental value/performance
- → Reducing raw materials usage and conserving natural resources
- → Solid waste or landfill space reduction and reduced toxic materials contamination
- → Elimination of the need for a new product
- → Reducing energy usage - less energy usage than recycling

### Economic Benefits

- → Cost savings in new material or product production
- → New profit opportunities from increased aesthetic values, design uniqueness, improved material qualities, adding value to materials to materials or products
- → Upcycled fashion offers uniqueness and viable business opportunities for brands
- → Household upcycling fulfills needs in cost effective ways and creates potential niche market opportunities

### Social Benefits

- → Alleviation of poverty in developing countries
- → Upcyclers develop object understanding across disciplines and cultures
- → Upcyclers create subjective beauty while maintaining the sentimental value of used products
- → Upcycling offers a meaningful journey, empowers learning experiences and creates a sense of community through networks while reducing stress

Upcycling can also be an enabler of social innovation, offering sustainable and socially meaningful as well as employment to marginalized groups such as migrants, unemployed youth, elderly or otherwise disadvantaged workers (Han et al., 2017; Wegener & Aakjær, 2016). To take an example, Jay & Co, based near Birmingham in the UK, works with young people at risk to refurbish furniture in surprisingly creative ways. As founder Jay Blades relates in an interview, some 50% of these people have gone on to work in furniture restoration, or further their education (Treggiden, 2021). With its unique upcycled designs, this kind of project inspires by its ability to deliver on all levels of benefits.

## Upcycling and the Circular Economy: Takeaways

- → Upcycling fits into CE principles as a circular design approach and through business models
- → Upcycling contributes to a transition towards the CE by dealing with the waste within our current material recovery systems
- → Upcyclers are circular entrepreneurs contributing to circular economy knowledge and innovation
- → Upcycling offers multiple environmental, economic and social benefits, including social innovation

# Upcycling and the Furniture Sector

As my design practice presented in this thesis focuses on upcycled furniture and object design, it is worth examining circularity initiatives in the furniture sector to situate current and potential application of upcycling practices in this regard.

## Current Furniture Industry

The global market for furniture is vast, with revenues expected to research $785 billion by 2027 (*Furniture Market Trends 2021*, 2021). With the prevalence of "fast-furniture", furniture waste is a significant problem in itself, recently estimated at 12 million U.S. tons in the United States, with 80.1% of these 12 million tons ending up in landfill, 19.5% combusted for energy recovery, and only 0.3% recycled (Environmental Protection Agency, 2018). In Europe, figures are similar, with 10.5 million metric tonnes of waste per year, approximately 10% recycled and 2% remanufactured (Erasmus+, 2017; Forrest et al., 2017).

According to Mishchuk, the industry's current sustainability practices are primarily concerned with eco-friendly and efficient use of materials in the areas of sourcing, design and production, and packaging and shipping. Industry associations offer certifications to reassure customers on these aspects (2022).

## Furniture Circularity Potential

A study on the European furniture industry's circularity potential showed it could reduce waste by ramping up refurbishment and remanufacturing suggested such a shift could result in a reduction of six million tonnes of CO2 and the creation of 157,000 jobs (Forrest et al., 2017). Furniture has been identified as a priority sector in the EU's Circular Economy Action Plan (European Commission, 2020), as well as in Canada, where it figures among the top six sectors offering high potential for revenue from value retention processes, particularly through reuse and remanufacturing (Oakdene Hollins and Dillon, 2021).

Further along the road of implementation, the EU updated its Green Public Procurement criteria for furniture in 2017 to include refurbishment, remanufacturing and reuse among its criteria and targets, which remain voluntary among the public authorities of the EU and its member states (Joint Research Centre (European Commission) et al., 2017, 2021). The EU has also recently proposed changes to its Ecodesign Directive to expand its scope include standards for product durability, reusability, upgradability and reparability, as well as remanufacturing (*Ecodesign for Sustainable Products*, n.d.), which, if implemented in the furniture sector, should facilitate the task of suppliers working with government organizations to meet their green procurement targets.

## Furniture Sector Repair, Refurbishment, Reuse and Remanufacturing

Extending the life of furniture by reselling it is clearly the most popular circular practice in the furniture sector. On a DIY and artisan level, repairing and refurbishing furniture are long-standing practices, and the vast majority of #upcycledfurniture posts on Instagram involve repainting, recovering or otherwise freshening up existing pieces. A few studios are also specialized in creative refurbishment, with Jay&Co and Patience & Gough elevating this craft to a whole new level.

On a larger enterprise scale, Ikea carries out cleaning and minor repairs as part of its buy-back program across many of its stores, whereby consumers can sell or purchase certain “preloved” Ikea items in good condition in “As Is” sections of the stores (Haigh, 2019). According to its website, the retail giant is now also offering spare parts and upholstery covers to extend the life of its furniture, and is currently trialing more extensive repair and refurbishment services at one store in Sweden.

The office furniture sector is generally seen as a good candidate for reuse and remanufacturing (Forrest et al., 2017; Oakdene Hollins and Dillon, 2021). Two exemplary manufacturers are Steelcase and Herman Miller, which have adopted cradle-to-cradle design principles and designing for easy disassembly (McDonough et al., 2013), making it easier for third-party remanufacturers such as Davies Office in the US or Rype Office in the UK to remanufacture and resell their products.

## Furniture Design Using Repurposed Waste Materials

Furniture made from reclaimed wood or wood offcuts is a traditional application of repurposing still often seen in DIY as well as commercial projects, but many examples exist using other materials, ranging from boat sails to bicycle parts. A Swedish design-with-waste project compared repurposing-driven upcycling processes in the furniture and fashion industries, and found furniture companies better positioned to integrate such an approach in their production due to their typically smaller, more localized, and more flexible production facilities and processes designed to produce smaller production runs (Hjelmgren et al., 2014).

As a design and manufacturing practice, furniture made using repurposing seems limited to micro enterprises as well as a handful of more structured small enterprises. A sample of projects from these companies are analyzed in Section 6: Comparative Analysis of Upcycled Furniture and Object Projects.

## Upcycling and the Furniture Industry: Takeaways

- → The furniture industry generates a huge amount of waste, and has been identified as a priority sector for circular economy initiatives to focus on.
- → Current upcycling processes in the furniture sector are mainly limited to resale, repair and refurbishment, mainly on an individual and micro enterprise level.
- → Larger scale initiatives are rare, with a few exemplary cases in the area of office furniture remanufacturing.
- → The design of furniture using repurposed waste materials is happening mainly on a micro enterprise level.
- → Furniture producers are relatively well-positioned to integrate upcycling practices into their production systems due to their smaller size and flexibility

# Upcycling, Designer-Makers and Sustainable Craft

This section explains the connections between upcycling, designer-makers, and craft practices, and how these can both hinder and help upcycling enterprises in scaling up.

## Designer-Makers, Craft and the Maker Movement

The connection between upcycling and craft production traces back to its DIY origins, with many upcyclers today falling under the category of designer-makers. Upcyclers not only solve problems as designers but also leverage their skills and ideas while working with materials, processes, and available tools (de Castro Pereira, 2017).

The term "designer-maker" has gained popularity, particularly among full-time professionals in the contemporary craft and design market. Luckman and Andrew (2020) define these practitioners as

> makers who may undertake original design and prototyping themselves, but who, in order to scale-up their production in ways not always possible for a solo hand maker, outsource some or all subsequent aspects of production to other makers or machine-assisted manufacturing processes. (Luckman & Andrew, 2020, p. 13)

Upcycling through repurposing figures prominently in the contemporary craft sector, which has been experiencing a “third wave” of dynamic growth in recent years, driven by increased interest in “unique, innovative and/or handmade objects” (Luckman & Andrew, 2020, p. 5) and the idea of connection between consumers and makers (Page & Thorsteinsson, 2016).

The Maker Movement has injected new energy into craft by incorporating technology tools, knowledge sharing in shared spaces and networks, and fostering social exchange and collaboration (Blikstein, 2014; von Hippel, 2005; as cited by (Browder et al., 2019). Craft offerings have gained visibility through social media, Etsy and the Internet’s “long tail” of search results, enabling makers to connect with communities of interest and potential buyers (Fox Miller, 2017). The abundance of both upcycled objects available online suggests upcycling has benefited from this movement.

## Upcycling as Sustainable Craft

Like upcycling, Craft offers a “subversive”, or at least an alternative form of consumer culture (Woolley, 2011). Both upcyclers and craft practitioners can embody sustainability through traditional skills and processes (Luckman & Andrew, 2020), ethical local production and consumption (Krugh, 2014; Luckman, 2015; as cited by Fox Miller, 2017), as well as quality, durability, collaboration, and social capital — all driven by the vision and values of the maker (Väänänen & Pöllänen, 2020).

Despite its sustainable qualities, researchers find tensions between craft and our current economic and technological worlds, namely in terms of production efficiency and viability, with gaps between the cost of craft and the income it generates (Zhan and Walker, 2019). However, they believe these tensions can be mediated, and see in craft "significant potential to contribute to transition, serving as an agency for sustainable transformation" (2019, p. 484).(2019, p. 484). In this regard, craft plays a similar role to upcycling.

### Craft Production Scale Flexibility

Craft production offers an inherent flexibility, which, given the right resources, can scale up or down to fit the needs of given projects. In his research on the connections between craft and industry,Woolley, 2011) notes this kind of adaptability enables a designer to shift their role from that of a craftsperson doing one-offs to a designer-producer with variable sizes batches. The case studies presented in section 5 of this thesis offers examples of this, as the two enterprises are able adapt — relative to their respective scales — to larger commercial contracts and the multiple units they require.

### Craft Synergies and Creativity

Craft brings valuable contributions to the practice of upcycling, particularly in terms of problem-solving. In creating upcycled furniture and objects for this research-creation project, the experience of working with the geometries and material properties of existing objects required me to pivot throughout the process. This kind of adaptability aligns with crafts's pluralistic approach to materials and processes. You are constantly testing out ideas, getting to know what the materials will allow you to do, trying one craft process, switching to another, and then sometimes going back to the first with a different approach arrived at through deduction or discussions with more experienced craftspeople. UK design professors Bramston & Maycroft find the upcycler is required to "push the boundaries of what is possible" and "develop an inherent understanding of existing and yet-to-exist objects" (2014, p. 128).

Craft also intersects with design and art practices, creating fertile ground for creative exploration. Woolley (2011) highlights how craft's interplay with design and art fosters innovation during concept development, prototyping, and production design stages. This "pervasive ethos" of craft stimulates interdisciplinary synergies, expanding the range of material and process options available and leading to innovative solutions (Fig. 3). These findings resonate with the role my craft interventions played in stimulating audience interest in my upcycled designs, presented in the design projects of section 4.

Figure 3. *Craft's Synergies with Art and Design*


*Note.* From "Beyond control: Rethinking industry and craft dynamics" by Wolley, 2011, *Craft Research*, 2, 1, p. 15

The sustainable design researcher further sees craft-type interventions adding value throughout new product development phases, including production and marketing (2011). This all dovetails with upcycling's use of existing materials. Material variations, such as the pattern on an advertising billboard used in a bag, or the numbers on a sail used in a chair, call upon the art and design skills of the person integrating these variations in the production process to do so in a way that adds value to the product. The acts of such artful material understanding and skill can then be captured, in a photo or video for example, and leveraged in social media to help create audience engagement with the designer-maker or enterprise through their upcycling process.

## Designer-Makers and Sustainable Craft: Takeaways

- → Upcyclers are typically designer-makers, bringing design thinking skills as well as craft's skills and material experience to bear on upcycling challenges, typically carried out through repurposing.
- → Upcycling is riding the wave of craft's recent revival, thanks to their shared counter-culture qualities, and the power of social media and platforms such as Etsy
- → Upcycling shares many characteristics of sustainable craft, including both its ethics and its tensions with the idea of production efficiency and viability (as is further explained in the following section).
- → Craft production flexibility help upcyclers scale up or down to meet the demands of specific projects
- → Craft's interdisciplinary synergies help to solve upcycling design problems, while adding value in the design, production and communication of an upcycled object.

# Scalability and Viability Challenges and Enablers

As a design problem, scaling up upcycling is a wicked one. This subsection presents the problem from the standpoint of both production scalability and business viability.

## What Scaling Up Means

The expressions “scaling” and “scaling up” have a range of meanings, many of which relate to businesses, i.e.: their operations, organization, volume, markets and financial performance. In a broader, triple bottom line perspective, scaling includes sustainability in the sense of positive social and environmental impact (Palmié et al., 2023). In the context of circular business models, scalability has been described as “ability to go from small initiatives to businesses with the capacity to displace linear systems and make circularity mainstream” (Hultberg & Pal, 2023, p. 4).

However, as Palmié et al. point out, the question of “what is being scaled up” is key (Palmié et al., 2023). In the case of a design and craft production-driven upcycling-driven manufacturing enterprise, we are talking about two very separate things:

Firstly, *scalability,* in the sense of organization and operations: *“an organization's ability to grow without being hampered by its structure or available resources when faced with increased production”* (Hayes, 2022 para. 4).

Secondly, *viability,* in the sense of the business: *“a business' potential for long-term survival and the ability to sustain profits over a period of time”* (Murray, 2022, para. 1). This can also apply to a specific project or product, as well as the enterprise as a whole.

These two dimensions of scalability and viability provide a key basis of analysis throughout the thesis sections that follow the theoretical framework.

## Why Scale Up Upcycling?

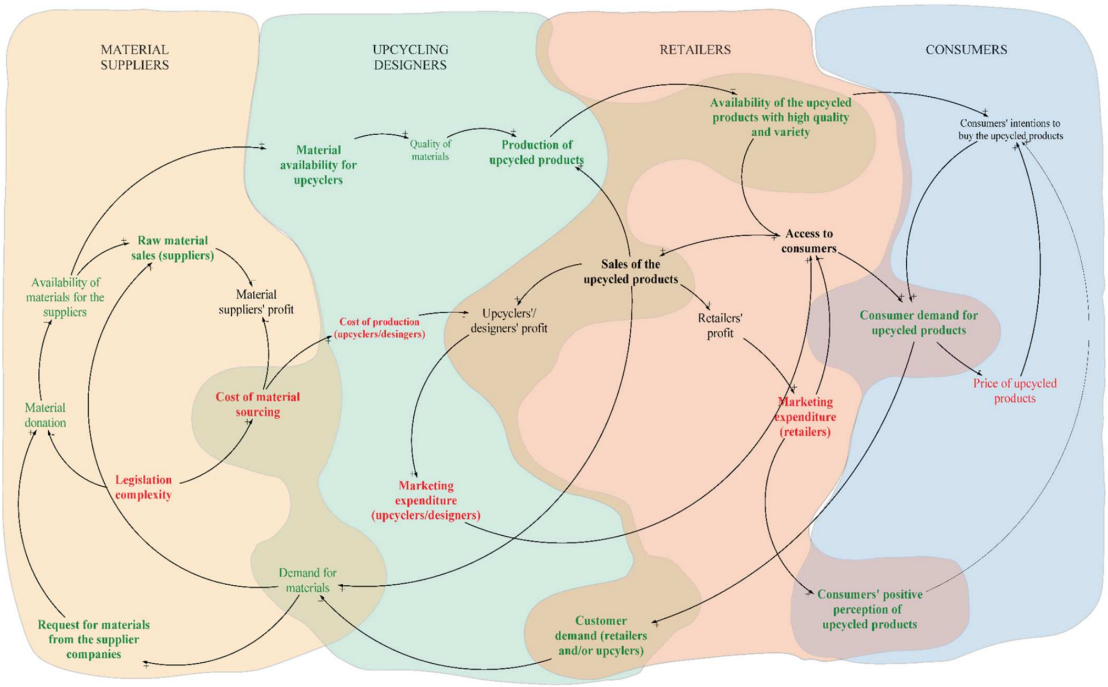
While scaling up is obvious from the standpoint of transitioning to the CE, for a designer-maker, the question of the need to scale up is worth asking. Small-scale production is a common characteristic of most upcycling enterprises (Singh and Ordoñez, 2016). When Luckman questioned designer-makers about the possibility of scaling up their production many expressed hesitancies related to the idea of giving up the making to others, increased responsibilities of managing others, and maintaining craft ethos (2018). Zhan and Walker also find that self-production offers the flexibility and customization possibilities that modern design needs to differentiate from mass-production (2019).

This all said, the designer-makers interviewed by Luckman also mentioned wanting to "make a good living," (2018). While this can be difficult for any design entrepreneur, the problem is compounded by working with waste objects and materials. Upcycling involves time-consuming and labour-intensive processes (Dares, 2021; J. Singh et al., 2019; Sung & Abuzeinab, 2022). Upcyclers also see declining value and increased product complexity in the materials they find, leading Singh and Ordoñez to conclude that scaling up is the only solution to ensure profitability (2016).

## Interconnected Challenges and Enablers

You only need to dwell on the problem of scaling up an upcycling business for a few minutes to realize how complex a problem it is. The question has been addressed through a major UK-based research project among various levels of stakeholders in the wood and textile sectors and experts on interventions for scaling up upcycling (J. Singh et al., 2019). One of the key takeaways was the interconnected nature of challenges facing stakeholders across the upcycling value chain (Fig. 4).

Figure 4: *Causal Loop Diagram of Challenges and Enablers in the Upcycling Value Chain*




*Note.* From "Challenges and Opportunities for Scaling up Upcycling Businesses – The Case of Textile and Wood Upcycling Businesses in the UK." by J. Singh, K. Sung, T. Cooper, K. West, O. Monta, 2019, *Resources, Conservation and Recycling* 150, p. 11. (https://doi.org/10.1016/j.resconrec.2019.104439)

It's easy to imagine their cascading effect: a lack of material availability for material suppliers means insufficient material quality and quantity for upcyclers, which in turn impacts production efficiency, and subsequently product availability, quality perceptions and pricing for retailers and consumers alike. Conversely, positive conditions occurring at various stages in the value chain translate into enablers, such as, say, the opening of a material reuse center in a given area, which can suddenly enable a reliable supply of certain types of material.

Among challenges for upcyclers, Singh et al. noted a lack of access materials, as well as the important resources of affordable space and equipment, as well as having the time and skills required. The researchers carried out a workshop with experts, who identified the need for education and expertise to help upcyclers produce high-quality products (J. Singh et al., 2019).

Upcycling's challenges and enablers operate on different levels of socio-cultural, political, economic and business perspective, and corresponding stakeholder influence. A recent business-focussed literature review of these factors by Caldera et al. (2022), across a wide variety of sectors (including food) proposes a three-tiered approach:

- ‘Macro’ refers to perceived structural, legal, regulatory and economic external conditions and that are beyond the influence of individual enterprise;
- ‘Meso’ refers to local institutional factors and influences, as well as community issues that often describe the parameters of product manufacturing;
- ‘Micro’ refers to day-to-day practices and attributes or characteristics of individual enterprises and their practice environments that affect how products are manufactured.

  (Caldera et al., p. 12)

An upcycling startup would do well to take all of Caldera et al.'s summary of challenges (identified here as barriers) and enablers into consideration, and then focus on how they can address the ones they have some influence over (Table 1 and 2). The micro-level barriers and enablers, which are the focus of this thesis, are more directly in the wheelhouse of a design entrepreneur, such as training employees and suppliers, or creating one's own supply network. Meso-level community issues can also be tackled, potentially by networking with other upcyclers to organize activities, such as, say, a yearly exhibition of sustainable design to raise awareness among government actors, the media and consumers.

Table 1: *Summary of Upcycling Barriers*

| Barriers type | Details | References |
|---|---|---|
| Macro-barriers | Lack of policy and regulation systems, | [68] |
| | Lack of funding schemes and incentives | [14] |
| | Existing stringent standards focused on conventional construction materials and techniques, making use of non-standard materials difficult | [15] |
| | Political powerlessness and instability | [68] |
| Meso-barriers | Negative attitudes toward using waste as a raw material | [16, 17] |
| | Limited financial resources | [16, 17] |
| | Socio-psychological factors such as approval from others | [17] |
| | The lack of unified and generally acceptable standards affects the operation and development of the recycling industry | [20] |
| | Lack of consumer awareness and knowledge | [16, 20, 65] |
| Micro-barriers | Lack of knowledge and clarity on upcycling opportunities (limited skills, imagination, inspiration and information | [14, 20, 56, 90] |
| | Absence of resources (money, men, machines and space) | [30, 38], [90-93] |
| | Poor quality of upcycled products, product composition complexity, and lack of transparency of material ownership | [16, 90] |
| | Marketing one off upcycled products are challenging | [15,[94] |
| | High price of the upcycled product | [38, 92] |
| | Contamination interactions limit the application of the upcycled objects | [15] |

Table 2: *Summary of Upcycling Enablers*

| Enabler types | Details | References |
|---|---|---|
| Macro-enablers | Provide support for waste upcycling education, endorsements, resource hubs | [65, 96] |
| | Better mobilization of resources and knowledge | [97, 86] |
| | Promote circular spirits and capacity building for entrepreneurs | [38, 98] |
| Meso-enablers | Facilitate community awareness and support | [65] |
| | Networks for social innovation and encouraging more people to engage in upcycling | [17, 30, 98] |
| | Use of material flow accounting to show the created value | [51] |
| | Strengthening system-level waste solutions and social awareness | [97, 99] |
| | Advocate reuse over recycling | [16] |
| | Provide design guide for upcycling with less time, efforts and money | [14] |
| Micro-enablers | Shift in cultural perceptions | [15, 100] |
| | Optimise freely available material and bio-inspired procedures | [14, 56] |
| | Improve material provision | [30] |
| | Train employees and suppliers and experiment development of new products | [30] |
| | Promote reverse logistics | [38] |
| | Take ownership, selling the uniqueness the story behind the product | [14, 56, 99, 101] |

*Note.* From "Evaluating Barriers, Enablers and Opportunities for Closing the Loop through 'Waste Upcycling': A Systematic Literature Review" by Caldera et al, 2022, *Journal of Sustainable Development of Energy, Water and Environment Systems* 10, 1, p. 9 and 10 (https://doi.org/10.1016/j.resconrec. 2019.104439)

Caldera et al.'s paper points out that many challenges are industry specific (2022), noting, for example, issues faced by building material upcyclers in trying to connect widely varied non-structural materials together (Bridgen et al., 2018; as cited in Caldera et al., 2022). Research among fashion designers doing upcycling in Canada illustrates the overarching challenge of scale with the devilish details of running an upcycled fashion business:

> The biggest challenge in fashion upcycling is in achieving economically viable mass production to create a scalable business. More efficient solutions for disassembly and cutting must be developed. Vertical integration of fashion upcycling companies is vital, efficiencies in the production process will lead to

> scale given that many of the phases may be conducted simultaneously. This requires collaboration among all of the stakeholders (trend forecasters, designers, production managers, selection teams, pattern drafters, drapers, cutters. and sewers) (Dares, 2021, p. 68, para. 3).

## Upcycled Product Perceptions

How consumers perceive and relate to upcycled products can also help or hinder product adoption and thus viability. This issue has generated some interest in the world of business academia with researchers exploring perceptions of upcycled products in various categories, notably in the area of fashion.

In terms of purchase drivers, marketing researchers measuring responses to a range of upcycled products find that *attractiveness* and *delight* (enjoyment) are two key reasons that explain why American consumers buy such products (Yu & Lee, 2019), while design researchers in the UK find that *design value* in the sense of *creativity, aesthetics* and *functionality* are more important purchase criteria than *greenness* (Buck & Lee, 2020).

Three studies on upcycled fashion highlight perceptual barriers to products made from waste. While fashion is particularly driven by social image, results from such research may also apply to furniture, a category where branding and image also plays a key role (Ratnasingam, 2022). The studies identify three key types of perceived risk:

- *Functional ris*k relates to fears of inadequate quality or performance (Yu & Lee, 2019), which can relate to durability or ease of care (Yoo et al., 2021), or to a lack of perceived utility, which can be interpreted as usability (Park & Lin, 2018) but also mean finding a product close to what you have in mind, such as the right size and colour (Dellaert & Stremersch, 2005, as cited by Park & Lin, 2018).
- *Social risk* can correspond to the product failing to impress one's peers (Yu & Lee, 2019) or potentially generating ridicule or other forms of negative feedback, issues which relate to self-image (Yoo et al., 2021).
- *Financial risk* relates to whether or not the upcycled product is worth the investment, which also has to do with price perceptions, or the risk of potential financial loss and the need to find a replacement (Yoo et als, 2021).

Researchers find that some of these perceived risks are less prevalent among respondents who have actually purchased upcycled products. Living with the products allows them to develop an understanding of and trust in the product's functional quality, performance and environmental benefits, and this trust then positively influences future purchase intent (Yu & Lee, 2019).

In terms of upcycling's associations to social risk, it's worth pointing out that Yu and Lee's study tested photos of upcycled "everyday products", such as fashion accessories made from low-cost materials, which may have affected perceptions.

In the luxury products arena, which many craft products belong to, upcycled products seem to have higher perceived social value. Italian researchers in fact find that upcycled luxury product propositions rated higher than similar but recycled ones in terms of pride and novelty. In their interpretation, sustainability acts as a signal of social responsibility and thus combines with the idea of financial status to generate a sense of pride among consumers. Both this social signaling and perceived novelty are more apparent with upcycled luxury concepts than with recycled versions (Adıgüzel & Donato, 2021). These findings dovetail with the ethical and storytelling values discussed earlier.

### Communicating Past Identity Salience

As explained in the Defining Upcycling section, how discernable the original purpose of an object is in the upcycled object relates to its storyful character. Past identity salience can also impact marketing and sales. Researchers tested point-of-sale material for upcycled products in a pop-up shop on a university campus and found that periods when the promotional materials emphasizing past identities of the products were displayed resulted in 60% more visitors and four times the sales revenues of other periods. Additional experiments showed that emphasizing past identities also increased Facebook ad campaign engagement (likes and clicks), as well as positive perceptions and purchase intent in product evaluation surveys (Kamleitner et al., 2019).

During the exhibition of upcycled objects designed within the practice-based component of this project, the relative salience of past identity was found to depend on the nature, form and evocative qualities of the material or object used in the design. This concept of past identity salience will be revisited in design study and case study sections of this thesis, as well as in the assessment of upcycling design prototypes.

The practical implications of upcycling perceptions will be addressed in the design practice section of this thesis.

## Upcycling's Scalability Challenges and Enablers: Takeaways

- → Scaling up an upcycling project or enterprise implies *scalability* in the sense of organization and operations, as well as *viability* in the sense of the business's ability to survive and generate profits
- → Scaling up production may not align with the hearts of all designer-makers, but upcycling requires a certain level of scale to be viable.
- → Upcyclers face interconnected challenges across the value chain, from material supply, to design and production, to distribution and consumption, making the problem of scaling up a systemic and wicked one
- → Key challenges for upcyclers include access to materials, affordable resources and expertise
- → Upcyclers can take on micro levels of challenges and potentially turn them into enablers, and through community building, can also tackle certain meso challenges
- → Upcycling challenges are also industry-specific, so tackling them requires finding specific technical and organizational solutions
- → Upcycled product purchase drivers are *aesthetics*, *delight*, *creativity* and *functionality* more than environmental benefits
- → Upcycled product purchase barriers are perceived *functional*, *social* and *financial risks*, however having actual purchase experience with upcycled products builds trust in *functional performanc*e and *environmental benefits*
- → Upcycled luxury product purchase drivers include *novelty* and *social responsibility* which relates to pride
- → Communicating the past identity of upcycled products can increase audience engagement and sales

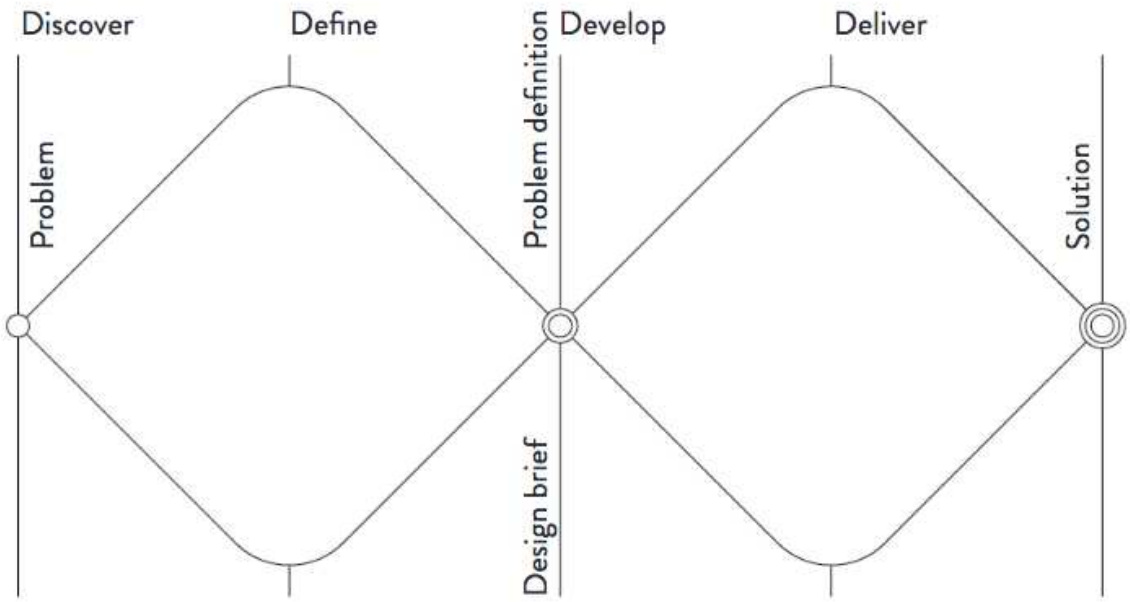
# Upcycling-Related Design Processes

Given the current prevalence and scale of practices, it's no surprise that upcycling remains ill-defined in terms of design processes and operational methods. This said, a few authors have addressed this topic from varying perspectives. As this thesis aims to model an upcycling design process, it is worth examining relevant processes that have been published to see what can be learned from them.

## The Double-Diamond

One of the most helpful starting frameworks for upcycling is the Double-Diamond (Fig. 5). Officially established by the UK Design Council over the course of 2003-2004, its roots can be traced back to 1970s era design community frameworks on divergent and convergent thinking, and diamond-like figures from John Chris Jones and Victor Papanek (Kochanowska et al., 2022).

Figure 5: *The Double-Diamond*




*Note*: Design Council, 2018

The beauty of this framework is its adaptability to many kinds of design problems:

- → *Discover*: Understand the problem and user needs in an exploratory research perspective
- → *Define*: Frame the design problem based on initial findings and insights to arrive at the design brief
- → *Develop*: Elaborate a range of potential solutions to the problem, using creative exploration, iterations and testing
- → *Deliver*: Select and refine a solution, with additional iterations and testing to arrive at the best result

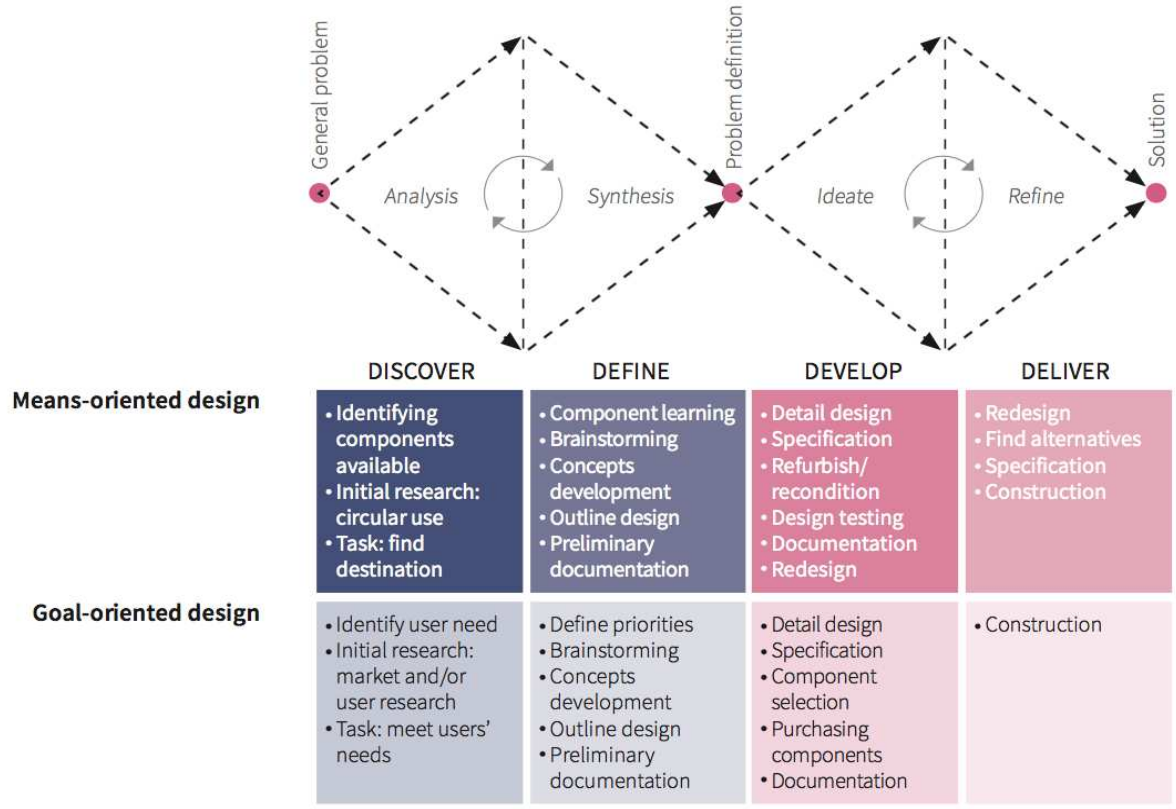
  (Ball, 2019; Kochanowska et al., 2022)

The Double-Diamond is particularly helpful when the outcome of a solution, ie: "the what", and or the way to get there, ie: "the how" is uncertain (Ball, N.D., as cited by Kochanowska et al., 2022). Uncertainty is an inherent part of upcycling design, where the designer is often starting with an object or piece of material and asking what they can make with it. So this framework is a good starting point for upcycling and Means-Oriented Design.

### Means-Oriented Design

Upcycling starts with existing material (ie: products, components, building materials, etc.), which in a broader sense can be referred to as "means." Starting from means is different than starting from goals. Traditional Goal-Oriented Design (GOD) implies every step in the process is driven by the project's end goals, from initial concepts to detailed design drawings and specifications. In the GOD process, materials are proposed, sourced and selected from a set of market suppliers as an outcome of the process. (Addis 2012, as cited by de Castro Pereira, 2017). Means-Oriented-Design (MOD) starts with a considered set of means, and sets objectives on the basis of factors such as availability, condition, physical properties and so on. As architecture design researcher Nicole de Castro Pereira explains it, the proposal of MOD is to "re-contextualize outdated, discarded, unwanted existing materials, elements, structures or buildings into a meaningful project and give their life cycle a second chance to be extended." (Pereira et al., 2016, p. 84). Figure 6 offers an adaptation of Pereira's comparison of MOD vs. GOD with process details for each, by Jörlén (2020), who has picked up on Pereira's work.

Figure 6: *Comparison of Means-Oriented Design vs. Goal-Oriented Design processes*

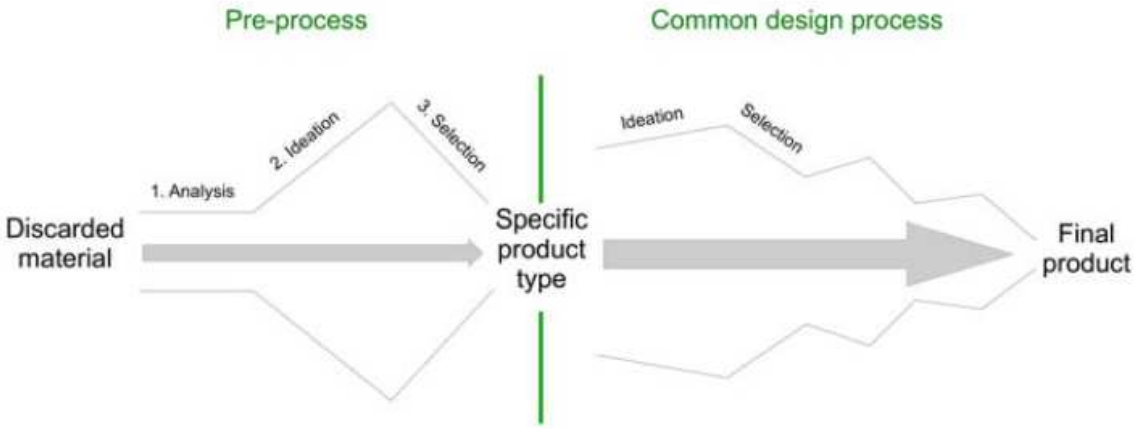



*Note.* From "Means-Inspired-Design – A design process proposal for a circular use of building materials" adapted from Pereria et al, 2016 by H. Jörlén, 2020, p. 27. (https://hdl.handle.net/20.500.12380/ 301369).

In upcycling, sometimes you start with a goal rather than a material, especially if you are thinking about building a practice around upcycling. Jörlén points out that design processes are never purely goal or mean-driven, and that functional requirements and other parameters can be in contradiction to MOD (Jong & Van der Voodt, 2002; as cited in Jörlén, 2020). Pereira affirms that material reuse is a continual learning process, with interim steps of material preparation or reconditioning, and the need to redesign in function of issues that arise along the way. She thus sees goals being set and reset throughout the MOD design and development process (2016). This finding echoes my experience with the design projects I developed within this research-creation project.

The Double-Diamond and Means-Oriented Design are applied in the research of Ordóñez & Rexfelt (2017), which analyzes six student-led waste-to-design projects involving objects. Common to the projects is a "pre-process", which starts with an investigation of sources of discarded material (Fig. 7A.)

Figure 7A: *Process Diagram for Designing With Waste*




*Note.* From "Designing from the Dumpster" by I. Ordoñez, O. Rexfelt, 2017, *International Journal of Sustainable Design* 3, 2, p. 61-78. (https://doi.org/10.1504/IJSDES.2017.091701).

The authors find this pre-process essentially boils down to three phases:

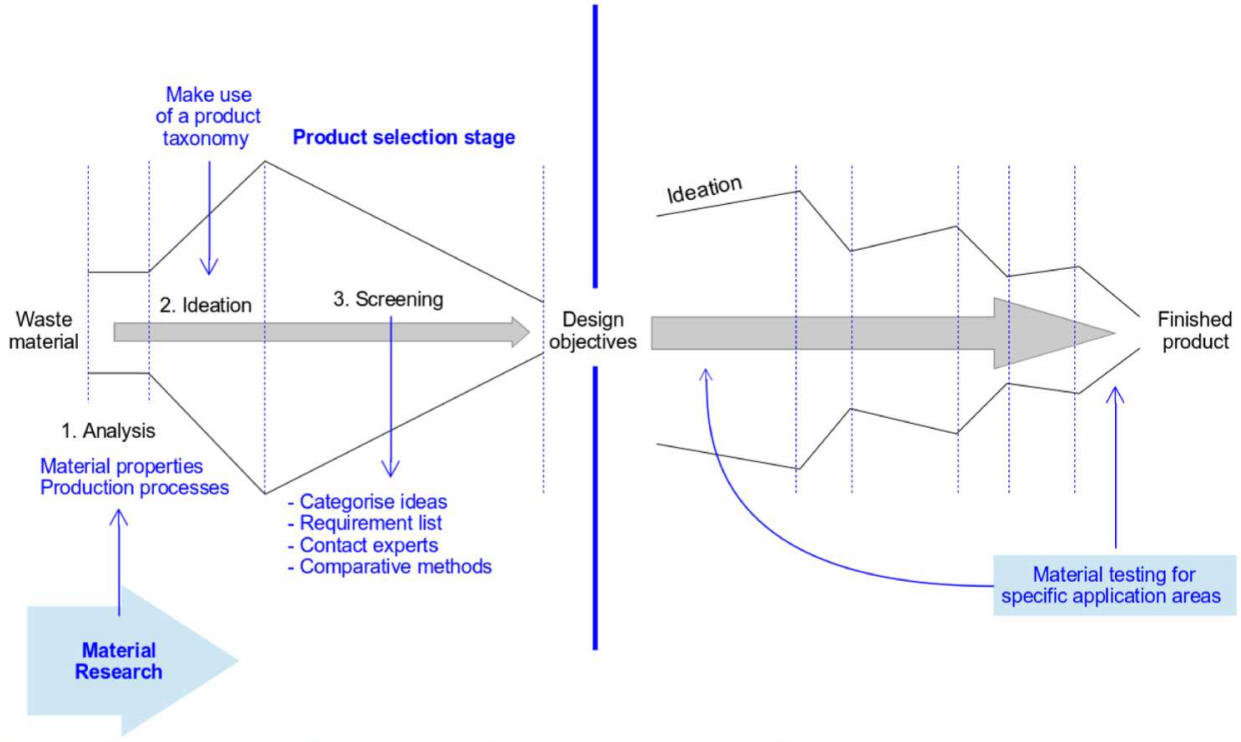
1. **Analysis**: familiarization with the discarded material through material analysis and research
2. **Ideation**: generation of ideas for product applications, based on the material information gathered
3. **Selection**: a screening process for the ideas generated to identify the most promising ones

(Ordóñez & Rexfelt, 2017), p. 70)

The researchers' interviews with design and engineering students about the pre-process underscored its importance, time implications, and the challenges faced. Not having access to source information or data on the material's properties created uncertainties, which were sometimes compounded by deterioration caused by the material's previous use. This forced the students to make assumptions, which were later proven wrong in the evaluation and selection phases involving consultations with industry experts, and market analysis. Concepts were thus eliminated, forcing students to reconsider others (2017).

In her licentiate thesis, Ordoñez (2014) brings some suggestions to structure this process, including conducting material research prior to ideation, developing a product taxonomy to identify potential application areas, and screening user requirements coming out of material research and comparative methods to rank concepts. This leads the researcher to identify the Double-Diamond mid-point as "design objectives", followed by material testing in the development stage (Fig. 7B).

Figure 7B: *Process Diagram for Designing With Waste - Annotated*




*Note.* From "Turning Waste Into Resources - Rethinking the Way We Discard Things" by I. Ordoñez Pizarro, thesis, p. 23, 2014

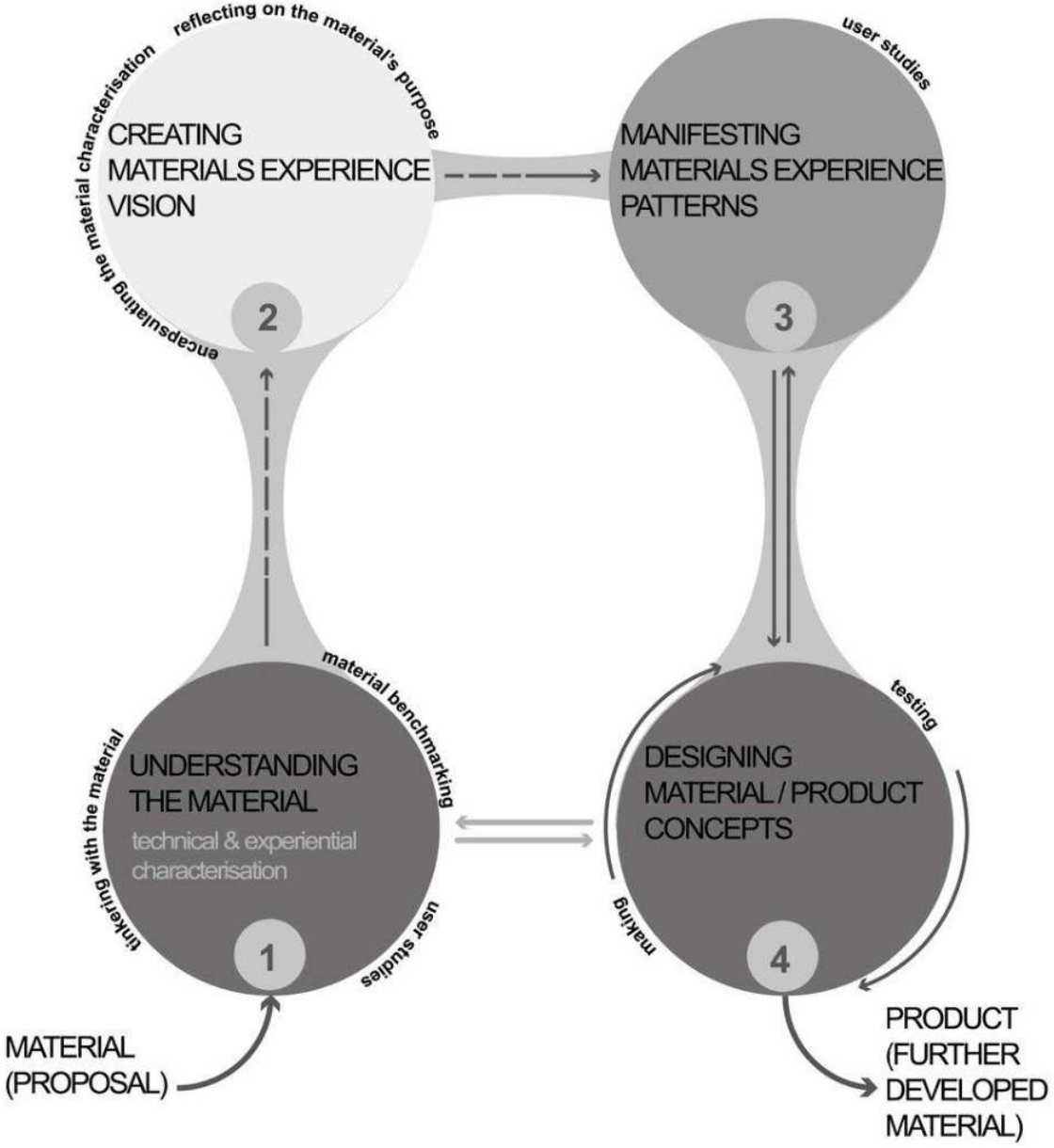
The process steps added by Ordoñez (2014) help to formalize methods for taking on an upcycling project starting from a waste material opportunity. Material research helps to understand affordances and processes required to work with the material. Elaborating a product taxonomy is a way to brainstorm potential products that can be produced, while the screening processes create a funnel to arrive at a potential selection.

## Material-Driven Design

Upcycling's tendency to start from materials raises the question of process for researching and selecting materials or combinations thereof. Helpful in this regard is Material-Driven Design (MDD), which goes beyond assessing functional and technical attributes to embrace a more holistic, experiential and contextual approach in evaluating material, "not only for *what it is*, but also for *what it does*, *what it expresses to us*, *what it elicits from us*, and *what it makes us do.*" (Karana et al., 2015).

The method requires the active involvement of the designer to explore all the possibilities of a material rather than take for granted what is known about it (van Boeijen et al., 2020). The method comprises four steps, which are presented in Karana et al.'s methodology schematic (Fig. 8), and which I have detailed in terms of activities in Table 3.

Figure 8: *Material-Driven Design Methodology*




*Note.* From "Material Driven Design (MDD): A Method to Design for Material Experiences" by Karana et al., 2015, *International Journal of Design* 9, 2, p. 40.

Table 3: *Material-Driven Design Process Steps*

| |
|---|
| **1- Understanding the material**<br><br>Utilization of various methods to characterize the material's affordances:<br><br>• Tinkering and testing to identify technical and mechanical attributes<br>• User studies to understand sensorial, aesthetic qualities as well as meanings, emotions, and behaviours<br>• Material benchmarking against other materials in the context of potential applications to generate broader insights on the material's value and constraints in usage |
| **2- Creating a materials experience vision**<br><br>Based insights from step 1, articulation of a vision for the material related to its potential role or contribution on a product performance, user experience, societal or planetary level:<br><br>• Analysis and clustering findings from step 1<br>• Mood boards as required<br>• Identification of potential roles for the material<br>• Drafting of vision statements and selecting one |
| **3- Manifesting materials experience patterns**<br><br>Confrontation of materials experience vision to user experience to understand the relationships between material's properties and their potential meanings for users:<br><br>• Identification of key concepts in the vision statement<br>• Elaboration of these as potential meanings for users<br>• Surveys (informal or formal) to see how these concepts and meanings are interpreted by people based on their own material experience<br>• Identification and map out patterns of interpretation |
| **4- Creating material/product concepts**<br><br>The designer develops physical manifestations of material or product concepts and tests these against the materials experience vision and requirements.<br><br>• Prototypes of prepared/processed/transformed material<br>• Prototypes of actual objects or products from the material |

Note: Authors elaboration based on Karana et al., 2015 and van Boeijen et al., 2020

The MDD process seems particularly well suited to new or unfamiliar materials, such as biocomposites or "smart materials", for example, but has also been used in projects involving the upcycling of waste materials (Bak-Andersen, 2018; Bofylatos, 2022; Sherlock et al., 2022). In an upcycling scenario, the material can correspond to complete products, which may need to be disassembled to explore their parts. Often, upcycled materials need to be combined within one another, or with virgin materials, to create a finished object. Such juxtapositions can be conceptualized and tested using mood boards, for example, by assembling rough prototypes, or by simply holding up materials next to one another.

Pereria (2017) affirms that for the upcycler, the discovery process is about seeing things differently than others, and honing in on the beauty and opportunity in waste. Considering the myriad possibilities a given set of upcycling materials can offer, the Material-Driven Design process suggests an effective way of optimizing divergent and convergent thinking across all the various types of technical, experiential and contextual affordances to arrive at a well-considered upcycling design project before investing too much time on prototyping.

### Rematerial-Oriented Design

DIY upcycling projects are typically carried out in an intuitive way. You land on some material, you get an idea and you start tinkering with the material, seeing if the idea might work. There is something very liberating in this kind of freewheeling exploratory design process. Because the project is mainly for fun, if you fail, it's no biggie. When you're trying to build a viable enterprise around upcycling, the stakes are higher.

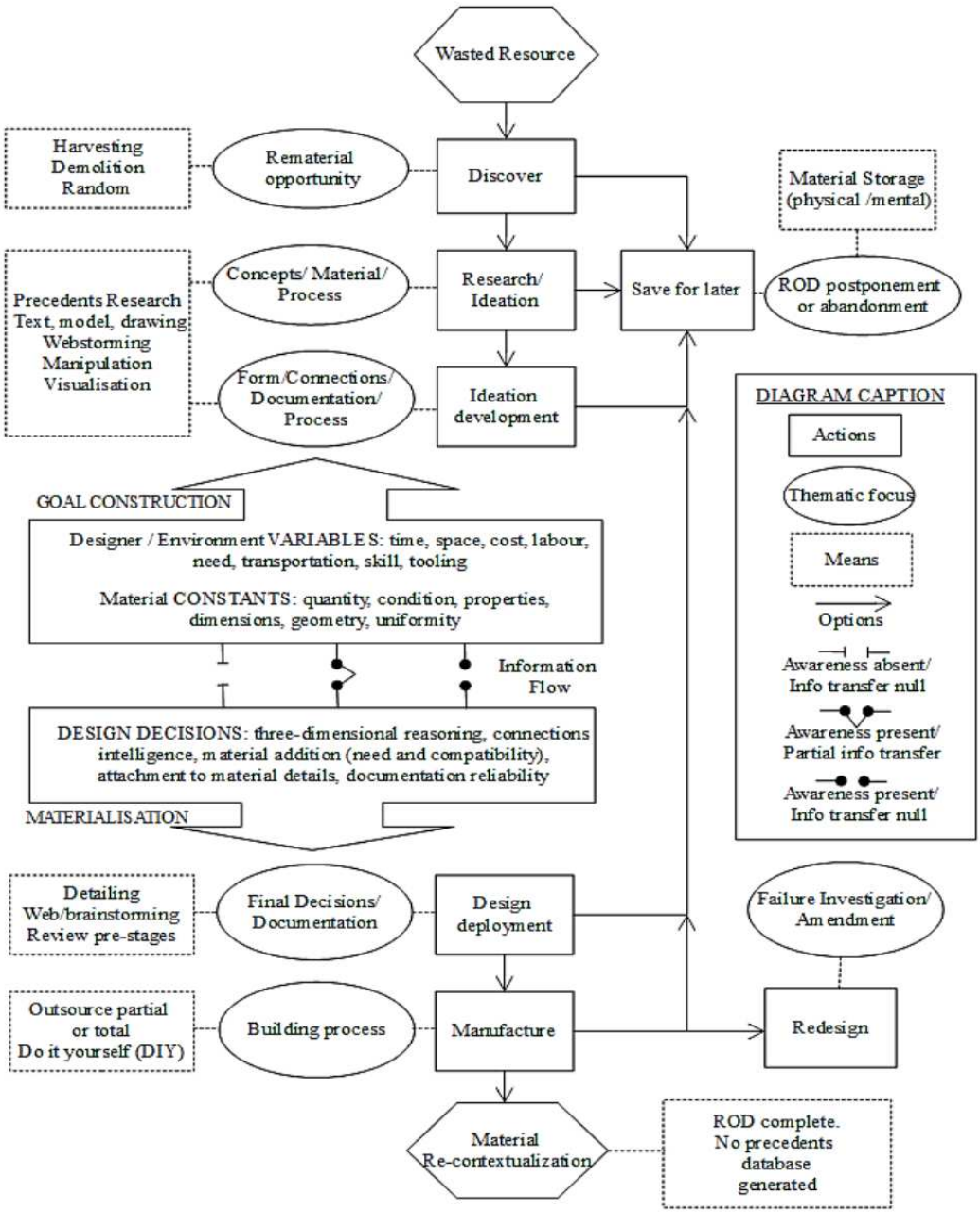
The architecture and construction sector deals in high volumes of waste which can entail high value reuse opportunities, and a few researchers have come up with useful frameworks to bring more structure to the process and reduce the risk of failure. In her thesis on "Rematerial-Oriented Design," architecture researcher Nicole de Castro Pereria identifies four types of situations faced by an upcycler:

- Goals, materials and processes are known; skills and tools are available.
- Goals, materials and processes are known; skills and tools are unavailable.
- Goals are known, but material and processes (and thus skills and tools needed) are yet to be defined.
- Materials are known, but goals and process (and thus skills and tools needed) are yet to be defined.

(Pereria, 2017, p. 58-59)

Seeking a more effective and cognizant process for upcycling-driven designers and architects, Pereira studies projects carried out by upcyclers of various skill and experience levels to identify interactions between design process, design knowledge and materiality. She presents her findings in a "reference model" (2017) (Fig. 9).

Figure 9: *Reference model for Rematerial-Oriented Design*

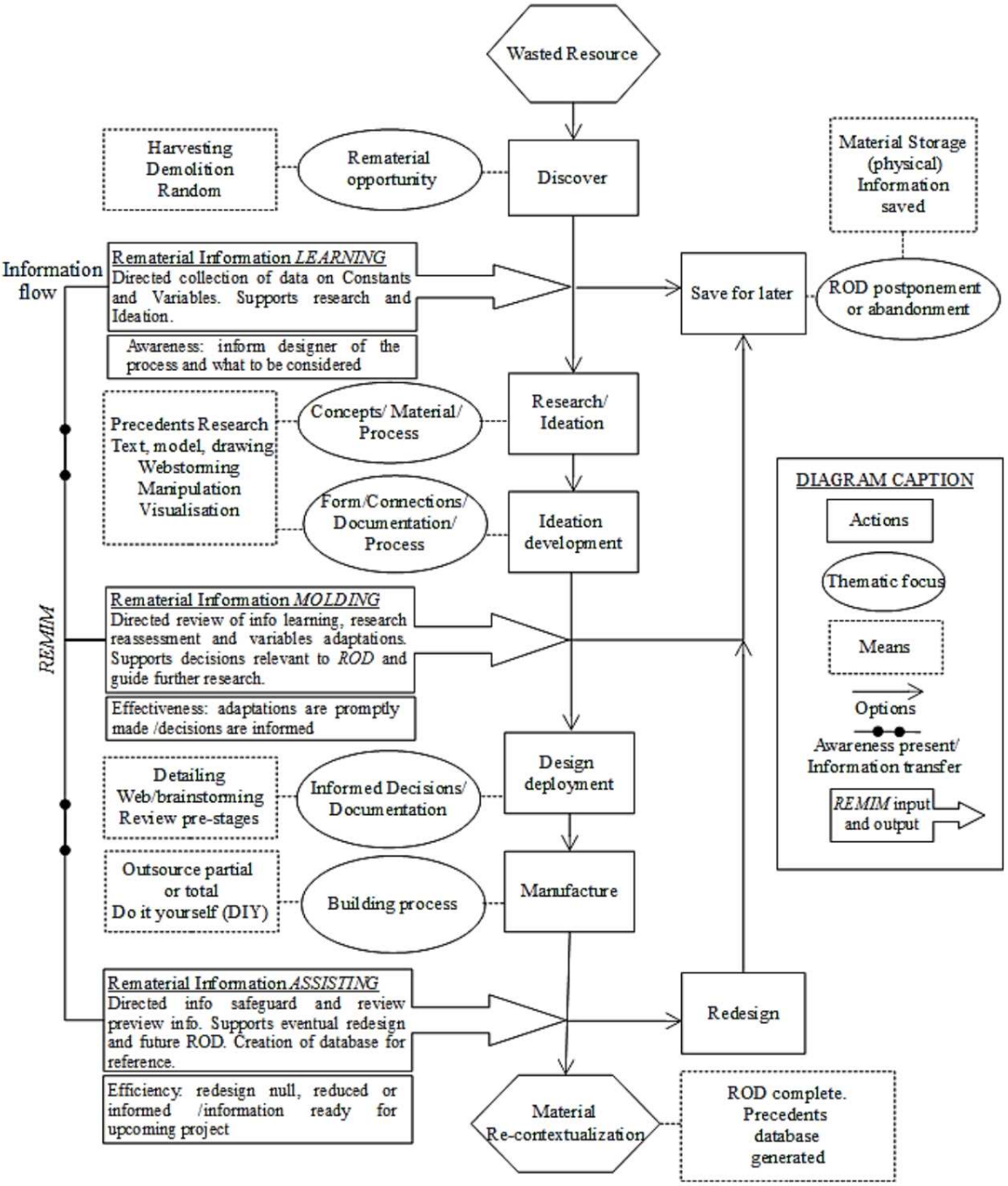



*Note.* From "Rematerial-Oriented Design: A Framework for Architectural Upcycling" by De Castro Pereira, 2017, p. 115.

Pereira's reference model broadens the framework for upcycling opportunities, proposing the option of saving a project for later and storing the material, as well as redesign as a possible outcome. The model details the goal construction process in terms of designer/environment (resource) *variables* (time, space, cost, labour, need, transportation, skill, tooling), and material *constants* (quantity, condition, properties, dimensions, geometry, uniformity). The author finds that reuse projects are chronically inefficient because information related to these parameters is not captured and

managed. Regardless of the experience level of the practitioner, the specificities of each new project basically mean starting over from scratch, complexifying the decision decisions that arise from goal construction. (Pereira, 2017). To remedy this situation, Pereira proposes an impact model based on "rematerial information modeling (REMIN)" (Fig. 10).

Figure 10: *Impact Model for Conscious Rematerial Oriented Design*




*Note.* From "Rematerial-Oriented Design: A Framework for Architectural Upcycling" by De Castro Pereira, 2017, p. 118.

By harnessing data related to how material constants of previous projects have impacted the designer and resource-related variables, Pereira's rematerial information model proposes some clear benefits for projects at three stages in the process, as described by the researcher:

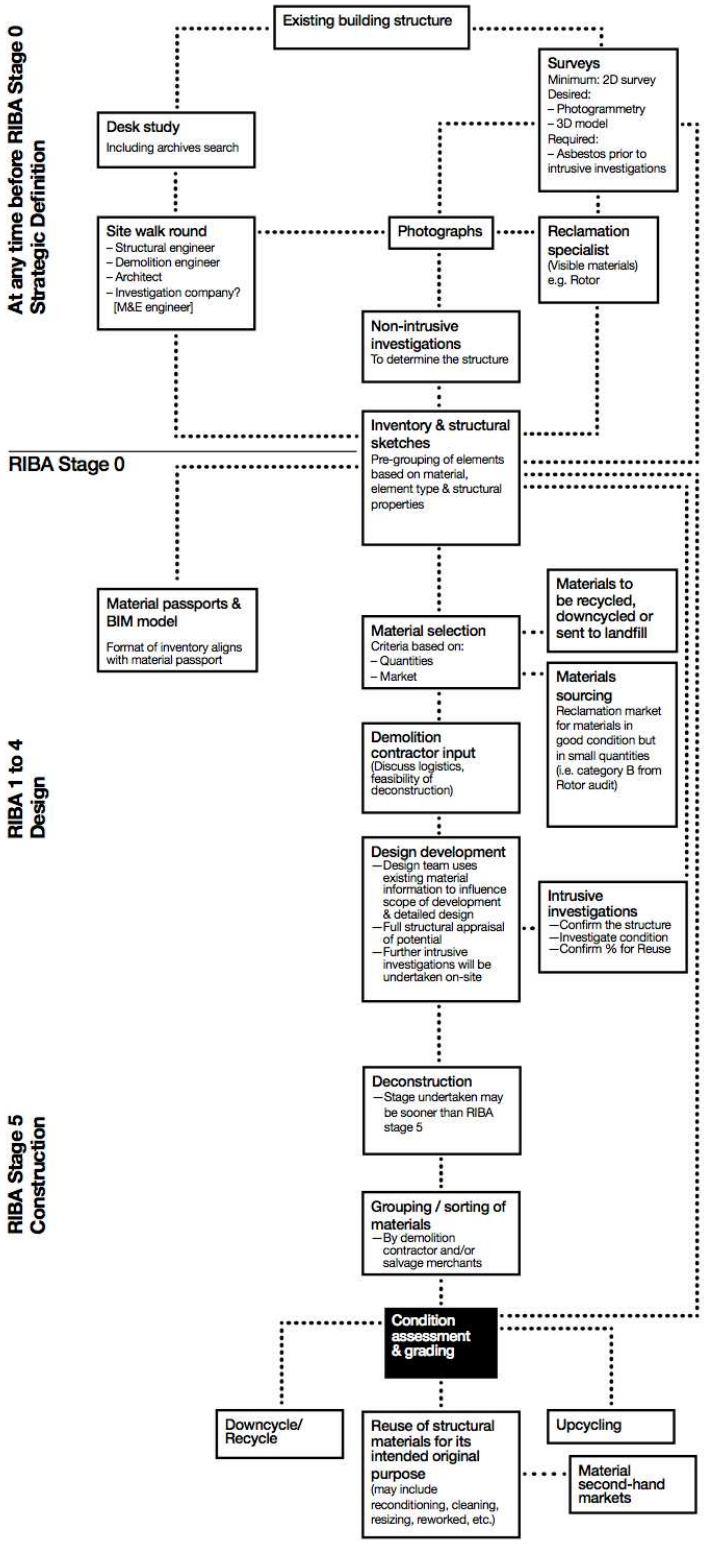
- → **Research and ideation**: the data broadens understanding of material and resource affordances and constraints, adding focus to this stage
- → **Ideation development**: the data helps assess design concepts and the possibility of adapting variables to accommodate the project, informing the go/no-go decision
- → **Manufacture**: the data reduces need for redesign, or if required, informs the redesign process

For a designer envisioning building their practice around the design and development of a range of upcycling projects, designing a system to capture and manage such information makes absolute sense from the standpoint of the efficiency, scalability and viability of their practice.

### Architecture and Construction Reuse Guidelines

Reuse-related processes in the architecture field have advanced to the point of guidebooks being published on the topic. These contain detailed schematics regarding various aspects of the process from technical and project management standpoints. Figure 11 provides a good example of an overview-level schematic in this regard, which maps reuse processes into the Royal Institute of British Architecture's Plan of Work for architecture and construction projects. The pragmatic nature of this type of process with its detailed steps makes it readily graspable for the practitioner. The proposed design process for the upcycling of objects later in this thesis will aim to offer a similar level of detail in terms of practical steps and guidelines for implementation.

Figure 11: *Architecture & Construction Reuse Process Overview*




*Note:* From "Full Circle to Reuse", by Elliott Wood and Grosvener, 2021, p. 15

## Upcycling-Related Design Processes: Takeaways

- → The Double-Diamond and Means-Oriented Design are foundational design process frameworks for upcycling
- → Upcycling design processes are however never purely means or goal-oriented; you can start with materials and make a plan, or start with a rough plan and find materials
- → Process for Designing With Waste proposes a *pre-process* comprising practical methods of analysis, ideation and screening leading to *design objectives*, which guide the rest of the project's development process
- → Materials-Driven Design offers ways to assess material beyond its technical and functional attributes and explore its experiential and contextual affordances, a framework particularly useful for unfamiliar materials and combinations of materials
- → Rematerial-Oriented Design broadens the framework to assess, and as relevant, save for later, develop and redesign upcycling projects, considering material constants, and variables relating to skills and resources
- → Rematerial-Oriented Design proposes an information model to capture, manage and leverage information from previous reuse projects to bring greater efficiency and effectiveness to subsequent ones
- → Architecture and construction-specific reuse guidelines are helpful in the level of process detail and the pragmatic steps they propose

# Summary and Gaps

## Defining Upcycling

Upcycling is often interpreted in a way that includes certain recycling activities, refurbishing, and remanufacturing. Upcycling through repurposing represents the original spirit of the term upcycling, using an object or material to create a new object, while maintaining some recognizability of the discarded material's original purpose, and increasing value in the process on all four levels, i.e.: by adding design/creativity, sustainable, ethical and storytelling attributes to the object. When an upcycled object's previous identity is recognizable, we can "read" its story of transformation, sparking our imagination and making us feel a stronger connection with the object.

## Upcycling, the Circular Economy and Furniture

In the CE, upcycling activities correspond to circular design and circular business models. Despite its multiple benefits, upcycling practices remain niche. Yet as the CE faces vast challenges to its implementation, upcycling offers a transitional approach to deal with the waste using our current material recovery systems.

With the vast amount of waste it generates and its typically small scale, flexible production systems, the furniture sector has been identified as a key sector for circular economy initiatives. Thus far, the sector's upcycling-related activities have been essentially individual or micro-scale and focused on resale, repair and refurbishment. A handful of more organized small, medium and large enterprise initiatives demonstrate the possibilities, notably with remanufacturing in the office furniture arena.

## Upcycling, Designer-Makers and Sustainable Craft

The vast majority of upcyclers are craft-driven individual or micro enterprises. Typically playing the role of designer-makers, upcyclers leverage design thinking as well as craft knowhow and material experience in upcycling projects, typically based on repurposing. Upcycling is a form of sustainable craft, sharing its positive ethical qualities along with its issues of production inefficiency and viability challenges. Yet craft production also gives upcyclers the flexibility to scale up or down according to project needs, while craft's interdisciplinary nature can help to solve upcycling design and production problems. Craftsmanship adds value to upcycling design and its communications.

## Upcycling's Scalability and Viability Challenges and Enablers

Scaling up upcycling implies both operational scalability and business viability. Upcycling requires a certain level of scale to help its practitioners earn a viable living. Challenges to scaling up are interconnected and systemic across the value chain. Key challenges for upcyclers include access to materials, affordable resources and expertise, and each industry can have its own specific technical and organizational challenges and corresponding solutions. Upcycled products are purchased more for reasons of aesthetics, delight, creativity and functionality than for their environmental benefits, while luxury upcycled purchases are more driven by novelty and social responsibility. Barriers to purchasing upcycled products are perceived functional, social and financial risks. Communicating the past identity of upcycled products can increase audience engagement and sales.

## Upcycling-Related Design Processes

Upcycling typically uses a Means-Oriented Design process, yet projects often shift between means and goals along the way. A "pre-process" gives focus to material analysis, concept ideation and screening to arrive at a clear set of design objectives, which guide the rest of the process. Material-Driven Design brings a more holistic approach to the material analysis stage, including experiential and contextual dimensions. Rematerial-Oriented Design further dimensionalizes upcycling project assessment and management, including capturing learnings on materials, skills and resources to bring efficiencies to future projects. The architecture and construction sector has developed detailed practical guidelines for working with material reuse.

## Research Gaps

As mentioned in the introduction, research on upcycling is still sparse and fragmented, notably in the narrower sense of repurposing, and related to the sectors of furniture and objects.

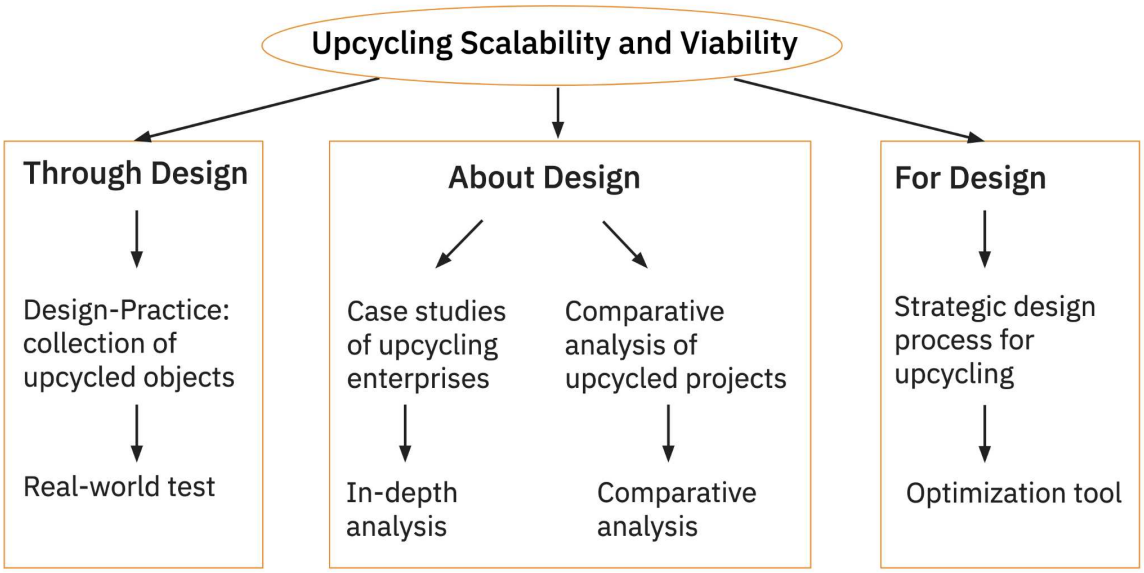
The bulk of upcycling research is related to specific case studies, however, these are typically focussed on the technical, educational or design aspects of specific upcycling projects and lack a broader perspective on upcycling enterprise operations. Research on scaling up upcycling has adopted an omniscient approach, tackling macro and meso-level factors as well as micro-level ones, and thus has not had the opportunity to go in detail on the practical production and business requirements for scaling up.

While there has been some research related to upcycling and design processes, this either hasn't offered granular details on the steps involved, or has been focused on reuse in the field of architecture and construction. In general, processes have not sufficiently addressed the business viability dimensions of upcycling projects.

# Section 3
# Research Methodology

To fill the research gaps identified in the theoretical framework in regards to the research questions of upcycling scalability and viability outlined in the first section of this thesis, this research project has adopted specific methods and approaches relating to all three forms of design research (Fig. 12).

**Figure 12:** ***Overview of Research Methods Employed***




The phases, objectives and steps of these research methods are detailed below, numbered according to their respective thesis sections, which follow this one.

## Section 4: Design Practice Research-Creation

### Research Objectives

Carry out a design practice-based upcycling project from material sourcing through to design, prototype development and exhibition as a test case of material sourcing and upcycling scalability and viability.

### Research Steps

1. Determine a list of potential waste materials of interest, and corresponding product categories, industry sectors and organization types.
2. Identify and survey local manufacturers to evaluate their feasibility as sources of waste materials for upcycling.
3. Select source(s) of specific waste material to work with.
4. Assess and explore material possibilities.
5. Design and develop a range of functional upcycled object prototypes to explore design and scalability possibilities.
6. Exhibit the resulting prototypes at Concordia's MDes graduate exhibition.
7. Review and learn from the process and resulting projects.

## Section 5: Furniture and Object Upcycling Case Studies

### Objective

Analyze case studies from a thorough operational and business perspective to gain in-depth insights into the material sourcing, operational processes, scalability, viability and success factors of upcycling-oriented design enterprises.

### Research Steps

1. Select two upcycling-oriented furniture and object enterprises that have attained a certain level of scale and viability using different approaches to material sourcing and production.
2. Review information published by the businesses via their websites and social media, as well as media coverage of the companies.
3. As feasible, conduct interviews with principles of the companies.

## Section 6: Comparative Analysis of Upcycled Furniture and Object Projects

### Research Objective

Conduct a design review comparative analysis of scalability and viability factors across a range of upcycled furniture and object projects.

### Research Steps

1. Select five design-driven upcycling projects in each of four categories: chairs, small tables, lighting and bags.
2. Assess each project on the basis of materials, source characteristics, design and production approaches, current production system, and scalability.
3. Identify good practices in terms of material sourcing, production, distribution and communications.

## Section 7: Upcycling Design Process Development

### Research Objectives

As a result of the aforementioned research phases, develop an upcycling design process for furniture and objects as a tool to help designer optimize the material sourcing, design and development of upcycled objects

### Research Steps

1. Elaborate a detailed proposal for an Upcycling Design Process for Objects.
2. Elaborate a list of success factors for the viability of upcycling projects/enterprises.

# Section 4
# Design Practice Research-Creation

As the creative capstone project of this research-creation design masters and in the continuity of my design practice, I have created a collection of upcycled furniture and objects. This section presents my observations and reflection on this experience, from material research and sourcing, through to design and exhibition.

## Material and Sourcing Research

### Material Research and Design Planning

While many upcycling projects start from material or a source of material, this project started instead with design premises. To give a framework to my research and development, I drew up a list of furniture and objects I was interested in creating, and potential material sources for each.

I carried out some exploratory Internet research into existing upcycled versions of each of these objects to get a preliminary idea of material and design possibilities. Then for each object category, I identified potential sources of waste materials in terms of industries and organizations, and the types of products the materials could come from.

With the idea of scalability in mind, the regularity of the waste flow was a key criteria, so I focused on manufacturing, commercial and institutional sources. To help frame the material research, I created an object-material source discovery matrix (Table 4).

**Material and Sourcing Research**

Table 4: *Object-Material Source Discovery Matrix*

| | | Potential sources | | Potential objects to be designed | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Industry sector or sub-sector | Product source | Shelf Shelving system | Tables | Sofa armchair cushions | Light | Bike bag | Rug | Storage unit |
| **Surplus, waste, or non-compliant materials or products** | Acrylic sheets | Restaurants<br><br>Government organizations<br><br>Public organizations | Protective dividers | x | | | x | | | |
| | Felt panels | Interior design companies<br><br>Acoustic panel makers | Acoustic panels | x | | | x | | | |
| | Carbon fiber sheet | Aeronautics<br>Automotive<br>Wind energy<br>Marine<br>Pipe & tank<br>Civil engineering<br>Sporting goods | Cabin flooring<br><br>Wind turbine blades | x | | | | x | | |
| | Aluminum sheet | Aeronautics<br>Automotive<br>Construction | | | x | | | x | | x |
| | Aluminum rod | | | | | | x | | | |
| | Steel rod | | | | | | x | | | |
| | Steel sheet | Shed manufacturers | Shed siding | | x | x | | x | | x |
| | Outdoor posters | Large cultural institutions<br><br>Outdoor media companies<br><br>Event companies | Event posters<br><br>Outdoor advertising posters<br><br>Event signage | | | | | x | | |
| | Aircraft components | Aeronautics | Aircraft components | | x | x | x | | | x |
| | Soft textiles | Hotel<br>Hospital<br>Garment<br>Healthcare | Sheets<br>Textile remnants<br>PPE mask offcuts | | | x | | | x | |
| | Hard textiles | Fire Departments | Fire hoses | | | | | | | |
| | High density polyethylene | Sporting goods | Kayaks | | | | | x | | |
| | Plywood<br>MDF<br>Lumber | Construction<br>Millwork<br>Cabinet<br>Furniture | Plywood, MDF & Lumber offcuts | | x | x | | | | |
| | Glass | Construction | Windows<br>Building panels | x | x | | | | | |

## Preliminary Selection of Industry Sectors and Object Categories

At this point, I was still faced with a vast array of industry sectors to start approaching, so I did some research to determine the feasibility of accessing materials within certain sectors. To further drill down the type and source of materials, I developed another matrix to evaluate these. Within the categories of waste sources, I determined five types of waste flows:

- **Offcuts**: remnants of material that is leftover as a result of production processes
- **Non-compliant**: components or products that have some flaws or do not otherwise meet quality standards, which can include returns under warranty, for example
- **Surplus or deadstock**: stocks of components or products which are considered outdated, have been delisted from catalogs or are otherwise considered unsellable
- **Outdated or obsolete**: products that are no longer in style or technologically obsolete or otherwise have fallen out of use
- **End-of-life**: products which have reached the end of their useful life according to the company's standards

For each type of source and material, I evaluated:

- **Form Consistency**: How consistent is the size and shape of the material
- **Volume**: small quantities, batches, or multiples
- **Waste Flow Frequency**: relative regularity or periodicity of waste flows
- **Key Challenges**: in terms of gaining access to or recovering the materials

Into this matrix, I inserted material I was considering from my object categories research or emerging from my manufacturer research (Table 5.)

Table 5: *Material Source Evaluation*

| Source Categories and Waste Flow Types | Material Examples | Material Form Consistency and Volume | Waste Flow Frequency | Key Challenges |
|---|---|---|---|---|
| **Industry** | | | | |
| Production waste/offcuts | carbon fiber sheet offcuts, N95 mask material | uniform multiples | continuous in function of product life cycle and manufacturing cycles | company authorization |
| Non-compliant components or product | print fabric, lighting component | mainly small quantities or batches | sporadic in function of suppliers and manufacturing process evolution | company authorization |
| Surplus/overstock components or products | lighting components or products (my research) | variable including batches | periodical in function of shifts in market trends and customer demand | company authorization |
| End-of-life products with EPR | aircraft components | uniform including batches | regular basis | company authorization, EPR/recovery system, transportation |
| **Construction** | | | | |
| Construction material offcuts | building material offcuts | variable form and volume | depending on projects | company authorization/policies |
| Surplus construction materials | building components, lumber, roofing | uniform small batches for each project | depending on projects | company policies/ existing resale networks |
| Decommissioned or overhauled buildings/facilities | building components, interior design fixtures, furniture | uniform variable batches for each project | depending on projects | lack of recovery suppliers/ access to sites |
| **Commercial/Institutional** | | | | |
| Outdated or no-longer useful products or materials | promotional signage, acrylic panels | relatively consistent multiples | depending on product or materials | company authorization |
| End-of-life components or products | hotel sheets, construction scafolding, flurorescent tubes | uniform multiples | regular and seasonal | company authorization |
| **Post Consumer** | | | | |
| Outdated, no-longer useful or unwanted products | furniture, appliances, decor, clothing | mostly variable form, single units | variable | recovery system establishment, recovery labour, time required to source multiples |
| End-of-life components or products | furniture, appliances, bicycle inner tubes, climbing ropes, sails | mostly variable - multiples in some categories depending on source | seasonal depending on category | recovery system establishment |

## Organizational Research

In parallel to my selection of material sources, I developed a research survey project to identify and assess the waste flows of companies and other organizations with the goal of shortlisting potential suppliers for a design project. I built a small database of organizations and contacts within certain sectors, including manufacturers, museums, and certain government organizations.

To build a database of contacts, I used government sources and North American Industry Classification System (NAICS) codes and product descriptions as search terms and geographic filters, which enabled me to get very specific in my research.

Given how often companies are solicited, I found it more effective to identify specific contacts within companies and then attempt to track down their contact information using Linkedin and Rocket Reach. Attempts to contact companies proved difficult, with bounced emails, contact center agents acting as gatekeepers, and multiple back and forths before being put in touch with a real person. Many people simply did not respond to email inquiries I was able to send, and it is very possible that many of the emails ended up in spam folders.

I managed to reach eight companies and carried out interviews with people at five of these. Small companies have mostly been easier to get through to, however, are much less organized in their waste management – they simply do not have the time or staff. Table 6 summarizes the results.

Table 6: *Companies Reached, Waste Type and Accessibility*

| Company type | Contact | Main products | Main waste types | Accessibility |
|---|---|---|---|---|
| Acoustic panel distributor | Director | Acoustic felt panels | Felt offcuts | Already working with students |
| Acoustic panel manufacturer | Project engineer | Acoustic felt panels, N95 masks | N95 mask offcuts polypropylene and polyester | Available |
| Bike sharing systems manufacturer | VP operations | Bikes, stations | (virtually none) | N/A |
| Recreational boat manufacturer | Sustainability Intern | Kakaks, canoes, paddle boards, fishing boats | Plastic offcuts, deadstock components | Available |
| Large national construction company | Director of sustainabilty | Buildings, civil engineering, infrastructure | Construction and demolition material waste | Already working with students |
| Mid-size construction company | Principal | Office and commercial buildings | Construction and demolition material waste | Difficult to access but potentially feasible |
| Global tire manufacturer | Regional manager | Tires, rubber tracks | Rubber offcuts, packaging | Potentially feasible |
| Lighting manufacturer | Continuous improvement and quality manager | Commercial and architectural lighting products | Deadstock Non-compliant products | Available for projects other than lighting |

## Material-Source Opportunity Evaluation

Two additional types of material sources were researched and subsequently rejected:

→ End-of-life wind turbines: remote locations, huge blades, difficult to transport, technically difficult to work with materials

→ Aircraft components: difficult companies to contact, established global market of resellers for materials, several upcycling enterprises already offering products

Among eight companies contacted, five had waste sources available or potentially feasible to access pending company authorization. Among these, the tire manufacturer and mid-sized construction company were contacted late in the game and I wasn't able to speak with someone who could give me specifics on the nature of the waste material and its accessibility in time, so I dropped these leads.

*Covid19 mask offcuts:* the material seemed potentially usable as filling for sofa cushions. A sofa requires multiple materials plus skills like sewing I've never developed. Ultimately, the project seemed more daunting than other material and design project opportunities, so I set this one aside.

*Deadstock boat components:* At time of our discussion this mainly corresponded to 900 units of a discontinued model of foldable plastic seat component for a fishing boat, which seemed too specific in its design and function to design anything interesting with, except possibly booster seats for children. So I ruled out this source also.

### Lighting Manufacturer

The most fruitful material source, reached through a personal contact, proved to be the lighting company, Eureka Lighting. I was put in touch with Martin Lévesque, director of continuous improvement and quality. During a 45-minute call with him, I learned that lighting component manufacturing is done in Asia and product assembly is done in Montreal, with minimal local production waste. The company's main waste flows are:

→ Supplier packaging, a significant proportion of which is processed and reused in product packaging shipped to customers

→ Non-compliant parts, i.e.: test samples, parts not meeting quality control standards, or damaged in shipping are occasionally received from manufacturers and are not shipped back

→ Deadstock, i.e.: lighting components which have been delisted from the company's catalogue due to changes in company products or shifting design trends

(M. Lévesque, personal communication, August 18, 2021)

At the end of the call he agreed to have me visit the company at a later date to get a better idea of the possibilities. During my visit, I spent close to an hour exploring approximately 150 square meters of deadstock and non-compliant lighting components in their warehouse area (Fig. 13). The waste components, made from aluminum and steel, are a regular occurrence, and once or twice a year the lot gets sold to a metal recycler. Using information on boxes and taking photos, I made a list of components of potential interest and prepared a reuse agreement, which, responding to the company's competitive concerns, specified the material would not be used for any lighting projects. More on these selected components later.

*Figure 13: Deadstock and Non-Compliant Lighting Components in their Boxes*

## Material and Sourcing Research: Takeaways

→ *Endless possibilities*: The research process led to a wide variety of possible sector and organization types, corresponding product types, and companies as potential sources. I barely scratched the surface in terms of this exploration.

→ *Goals vs. means*: The goals of creating any specific object remain a fantasy unless you can actually get in touch with people from organizations to validate the nature, volume and accessibility of waste produced. Only when you can get your hands on the material can you really seriously consider what you can do with it, and then adjust your goals as a function of that.

→ *Contacts count*: I seriously under-estimated the difficulty of reaching people at companies and getting them to talk to me. Getting through the layers takes time, and contacts definitely make a difference.

→ Despite the limited sample size, my survey showed significant potential interest of companies, notably manufacturers, in sharing information and collaborating with designers to put their waste flows to good use.

# Material Exploration and Design Development

To properly assess what I had gathered from Eureka, I laid out what I could fit into Concordia's MDes studio (Fig. 14). The geometry of the pieces made for an attractive installation, and started to spark ideas for projects. I could see components of tables and other ideas from individual pieces.

Figure 14: *Eureka Lighting Components Unpacked in the MDes Studio*

From this point on, the phases of material exploration and concept ideation, as well as design development and prototyping, followed a more classic path. Details and images can be found in *Appendix B: Material Exploration and Concept Ideation*, and *Appendix C: Design Development and Prototype Making*. Takeaways from these phases, along with the impact of using lighting components as the main source of material, will be presented after the presentation of selected projects which follow.

# Design Projects

Seven upcycling design projects were developed to the stage of prototype and presented at the Concordia MDES22 graduate exhibition, with two projects displaying multiple units in the interest of demonstrating production scalability. This exhibition enabled a very qualitative assessment of audience reactions for each project based on their comments and interactions with the pieces.

The seven projects are the following:

1- Utensil Holder
2- Ring Chair
3- Leggy Table
4- Side Table/Basket/Stool
5- Half-Moon Shelf
6- Catch-All Pedestal
7- 70° Table

Projects 1 through 4 are presented in some detail below. The remaining projects are depicted in photos, with details available in *Appendix D: Design Projects 5, 6, 7*.

# Design Project 1: Utensil Holder

This wall-mounted up/down spotlight style light fixture is designed for outdoor use with a black powder coat (Fig. 15). With 48 non-compliant units, the spotlight's housing cylinders enabled testing the idea of scalability. Some had scratches on them, while others seemed near-perfect.

**Figure 15:** ***Spotlight Fixture with Black Powder Coating***

*Note.* Silene Out Double [Photo] (n.d) by Eureka Lighting
https://www.eurekalighting.com/products/silene-out-double/

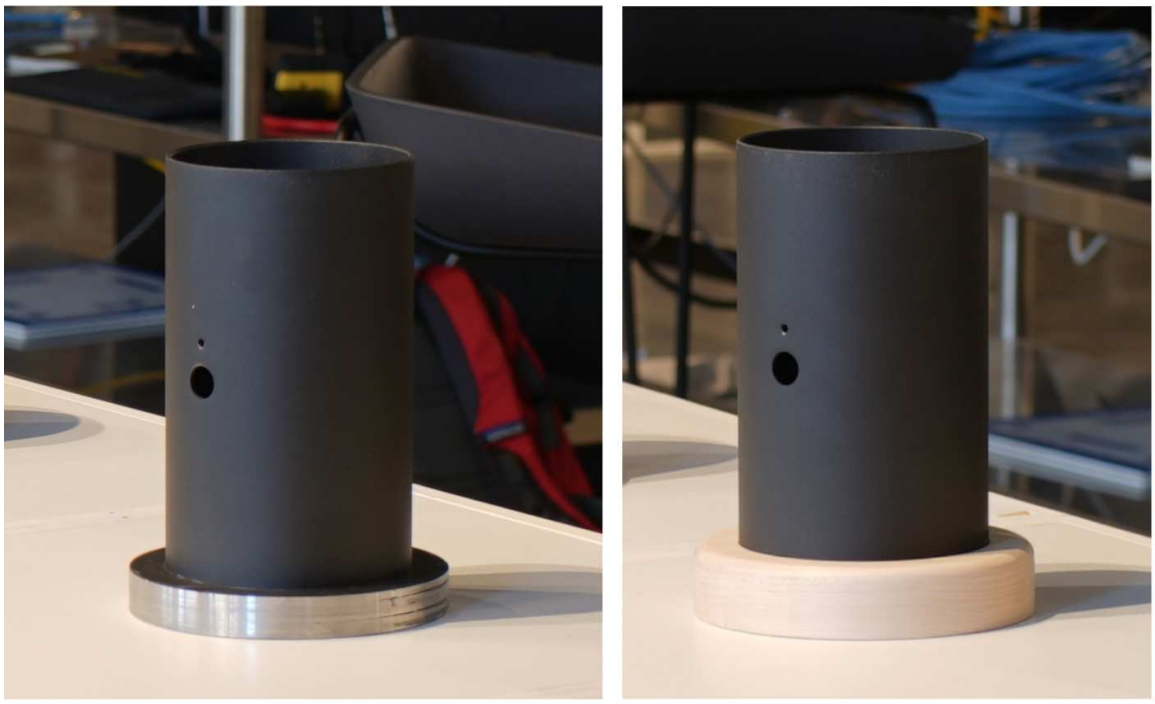
The cylinder seemed about right size and shape for a small countertop utensil holder. With its black coating it suggests a certain elegance — like the proverbial "little black dress". The challenge was to get it to stay up when larger utensils were tossed into it after washing up.

A steel base offered weight and a nice contrast against the black finish. Given this project was started late in the game, I sourced a suitably thick new 11 gauge sheeting.

Later realizing that thick metal was difficult to source, I switched to a wood base as lumber offcuts such as 2x6" are common enough to enable scalable production. Again for expediency, I picked out a new plank of thick maple from the wood shop. After some trial and error, I ended up outsourcing the routing of the channel and rounded edge profiling of the six discs to my woodworker friend Francis Bertrand.

The two prototypes came out nice in general (Fig. 16). The five welded pieces give a nice layered effect, while maintaining its small countertop footprint. With the wood version, Francis experienced some variations in the fit of the cylinder and used small clear self-adhesive silicone pads to ensure a tight fit with some pieces.

Figure 16: *Utensil Holder Prototypes 1 and 2*



Aesthetically, the wood and black metal combination feels like it is missing something. I have ideas in this regard for the next iteration, but an obvious one would be a finish to bring out the wood grain, which would be more prominent with other types of wood. The pre-drilled fixture holes of the cylinder beg the question, “why these holes?” They could be highlighted to help them work as a lead-in to the story.

Reception of audiences to the object on display during the MDES22 exhibition (Fig. 17) was very positive. They seemed drawn to these trim black objects as kitchen accessories, and became more interested when informed of the lighting origins of the material.

Figure 17: *Utensil Holders Displayed at the MDES22 Graduate Exhibition*

# Design Project 2: Ring Chair

The material for this project is an extruded aluminum ring with a C-channel groove in them, which forms the inner heat sink for Eureka's Cycle suspended luminaire (Fig. 18).

Figure 18: *Cycle Luminaire with Inner C-Channel Ring*

*Note.* Cycle Ceiling Suspended [Photo] (n.d) by Eureka Lighting
https://www.eurekalighting.com/products/cycle-10/

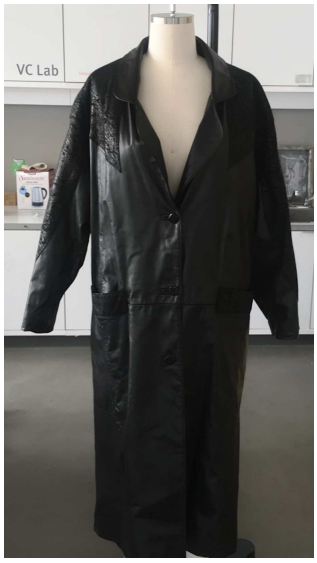
The C-channel makes the rings strong enough for an occasional chair, one with curvaceous art deco qualities. I sketched different concepts, thinking of leather for a seat, and did some research, which led me to a modernist version of an X-form style chair. Often referred to as Savonarola or Dante chair (Hoffman, 2011), Maison Jansen produced some in a Hollywood Regency style using chrome steel and leather (Fig. 19).

Figure 19: *Savonarola Chair by Maison Jansen*

*Note:* From "2 Maison Jansen Savonarola Chairs, Netherlands, 1970s (n.d.), retrieved from Whoopah https://www.whoppah.com/products/2-maison-jansen-savonarola-chairs-netherlands-1970s-xPnSRyuYP

For the leather, I found a womenswear-style long leather coat through a classified ad seller for ten dollars (Fig. 20). While still very usable as a coat, my sense of guilt in using it for the chair was somewhat alleviated by the circa 1980s animal skin style of its trim. To reinforce the leather, I purchased a roll of jute, which is commonly used in seating.

Figure 20: *Second Hand Leather Coat*




Working with these rings as structural forms required a detailed 3D model and a great deal of precision cutting and drilling to get everything to fit together. Three steel bars

hold the structure as well as the seat base together. To make the chair comfortable, foam upholstery seemed like a necessary evil.

The result (Fig. 21) is still a work in progress, but the curvy qualities are there, and the black leather works well against the shiny aluminum, a material introduced in furniture during the art deco era (C. Edwards, 2001). Ergonomically, the roll cushion forces the sitter into a very upright position, which doesn't make the chair relaxing in the conventional sense, but gives it an Alexander Technique style healthy posture quality. Future iterations will offer cushioning for the arms and will deal with sharp corners.

Figure 21: *Ring Chair in the MDes22 Exhibition*

The exhibition's audience was suitably impressed that lighting parts could result in a chair with this playful form. As a "concept chair," there was some apprehension about sitting in it, but once seated, people expressed surprise at the ergonomic qualities, enjoyed the feel of the leather and the statement qualities of the form. As an occasional chair, the relatively lack of comfort may or may not be a serious issue.

# Design Project 3: Leggy Table

Some of the nicest components I found among Eureka stock were spin-formed aluminum cylinders that has been discontinued from the company's catalogue. Very solid, the cylinders sparked the idea for table legs in a "chubby design" style. An outer aluminum ring of a 40 inch Cycle luminaire offered an apron for the table (Fig. 22).

Figure 22: *Lift and Cycle Suspension Lights by Eureka Lighting*

*Note*
Lift 4240 [Photo] (n.d) by Eureka Lighting, retrieved from Power & Lighting Systems Inc. https://pls.lighting.specseek.com/products/lift-4240/
Cycle Ceiling Suspended [Photo] (n.d) by Eureka Lighting https://www.eurekalighting.com/products/cycle-10/

Needing a tabletop, I turned to Facebook groups showcasing furniture abandoned on the street. After some false leads, I found a very solid round tabletop made of hickory, which my mother was able to pick up for me before someone else grabbed it (Fig. 23).

Figure 23: *Table Found on a Facebook Group For Abandoned Furniture*

To bring it all together, I cut the apron ring in two to fit the diameter, and allow for the table extension to be added when needed. Taking advantage of the hollow legs, I designed tops for them and small shelves inside using plywood offcuts and flat lighting components bent to hold them.

This project turned out to be the most labour intensive, disassembling, stripping and sanding the table, while stripping and gluing pieces of its existing apron together to make tops and feet for the legs. The cylinder legs required cutting, machining, filing and gluing, as well as more woodwork and metalwork for round tops, shelves and feet. Brackets to solidify the connection of legs to the table top are still in progress.

The outcome (Fig. 24) is as "leggy" as expected, but the shiny aluminum feels a bit industrial and out of place for a dining table. Adding a finish to the table will help bring out the wood's warmth, but I also have other ideas for version 2. The table maintains the extendable function of the original tabletop, and the additional leaf has also been reconditioned.

Figure 24: *Leggy Table at the MDES22 Exhibition*


Exhibition audiences seemed generally fairly impressed at the result, often assuming the materials were new. Somewhat perplexed by the chubby legs, they however expressed delight in opening the tops and discovering they could hold napkins and utensils inside.

# Design Project 4: Side Table/Basket/Stool

Another project was needed to test out scalability with multiple units, and with 14 Eureka's Skirt model lampshades (Fig. 25) with difficult to discern flaws that made them non-compliant for the company's quality standards. I had enough for seven units.

Figure 25: *Skirt Suspension Light*

*Note.* Skirt Ceiling Suspended [Photos] (n.d) by Eureka Lighting, https://www.eurekalighting.com/products/skirt/

Steel 15 gauge flat round components from another luminaire work here as tabletops, although the powder coating had to be ground off before plasma cutting the piece to size (Fig. 26).

Figure 26: *Flat Steel Lighting Component as the Basis for a Table Top*

As described in more detail in *Appendix C: Design Development and Prototype Making*, this project went through a few iterations, from the patterned steel table tops, to one made from wood shop offcuts (Fig. 27) glued into a chevron pattern. Thinking about scalability, I decided on a few more, using acoustic felt from Eureka's Mute luminaires (Fig. 28).

Figure 27: *Wood Shop Offcuts as Another Tabletop Material*

*Note:* Vertical Lumber Holder + Portable Scrap Wood Cart [Photo] (n.d.) by Vicki & Steph
https://www.motherdaughterprojects.com/blog/vertical-lumber-holder-portable-scrap-wood-cart

Figure 28: *Mute Light as a Softer Tabletop Material*

Note: Mute Ceiling Suspended [Photo] (n.d) by Eureka Lighting
https://www.eurekalighting.com/products/mute-2/

The felt really helped to bring softness and approachability to the end tables, as well as the possibility of patterns. The iterations also included two where the lampshades were inverted to form top and bottom-tapered baskets with smaller tops, one in steel, the other in felt.

The first interesting thing about this design is that it's formally modular: you can go from hourglass to basket shaped and back again simply by undoing the bull clips, flipping the two pieces and reattaching them. The second thing is that it is multifunctional: end table, bedside table, hidden storage receptacle, dedicated storage basket (Fig. 29).

Figure 29: *Variations on Table Tops and Forms, Suggesting Different Uses*

With the exhibition of these objects (Fig. 30), attendees quickly discovered another use: stools. As a result, two of the felt-topped versions were mildly damaged, as they were not designed to hold a person's weight.

Figure 30: *Side Table/Basket/Stool Variations at the MDES22 Exhibition*

The truly modular, multipurpose solution would be to have tops made of both steel, for strength, as well as felt, for some degree of comfort. Using it as a stool may also require something more solid than bull clips to prevent it from coming apart as people shift around on it, and perhaps attempt to use it as a stepping stool.

Structural and seating possibilities aside, people were most attracted to the wood top version, which speaks to the warmth of the material and the allure of craftwork when it is readily noticeable, such as in the chevron pattern of the wood pieces.

# Design Projects 5, 6, 7

See *Appendix D: Design Projects 5, 6, 7* for details on these additional projects, shown here in photos (Fig. 31, 32, 33).

Figure 31: *Project 5: Half Moon Shelves*

Figure 32: *Project 6: Catch-All Pedestal*

Figure 33: *Project 7: 70˚ Table*

# Design Projects Scalability and Viability Analysis

To analyze the scalability and viability of upcycling projects, I developed the following comparative analysis grid (Table 7). For my own collection (Fig. 34), it is based on a potential production system and the projected scalability and viability of each of the four main projects presented previously. This grid reappears in a slightly adapted form in the comparative analysis of upcycled projects of section 6.

Figure 34: *My Collection of Seven Design Projects at the MDes22 Graduate Exhibition*

## Design Projects Scalability and Viability Analysis

Table 7: *Design Projects Comparative Analysis Grid*

| |  |  |  |  |
|---|---|---|---|---|
| **Series/Object Name** | Utensil Holder | Ring Chair | Leggy Table (extendable) | Side Table/Basket/Stool (Wood top version) |
| **Potential Price (CAD)** | $70 | $650 | $1,900 | $300 |
| **Waste Material** | Non-compliant lighting component | Non-compliant lighting component<br><br>Leather coat | Deadstock lighting components<br><br>Discarded tabletop | Deadstock lighting component<br><br>Wood + MDF offcuts |
| **Waste Source** | Lighting manufacturer<br><br>Construction sites | Lighting manufacturer<br><br>Classified ads | Lighting manufacturer<br><br>Classified ads | Lighting manufacturer<br><br>Woodshop |
| **Waste Incidence** | Lighting: single batch<br><br>Wood: constant | Lighting: single batch<br><br>Leather: regular | Lighting: batches over given period<br><br>Tabletop: regular | Lighting: batches over given period<br><br>Top: regular |
| **Uniformity** | High | High | Legs: High<br>Tabletop: Low | Base: High<br>Top: Low |
| **Additional Materials** | Maple wood board<br>Silicone pads<br>Varnish | Upholstery webbing<br>Upholstery foam<br>Aluminum sheeting<br>Aluminum bar<br>Steel bar<br>Fasteners | Custom steel brackets<br>Fasteners | Fasteners<br>Wax |
| **Design & Production Approach** | Dimensioning lumber<br>CNC routing<br>Sanding<br>Finishing<br>Assembly | Structure: cutting, drilling, filing, assembly<br><br>Seat: seam removal, cutting, sewing, assembly<br><br>Cushion: foam shaping, cutting, gluing, sewing, hook & loop fastening, assembly | Tabletop + Leg tops: dismantling skirt, gluing skirt pieces, cutting, stripping, sanding, staining, varnishing<br><br>Legs: cutting, gluing, drilling + Brackets cutting, grinding, drilling, tapping + Skirt: cutting, drilling<br><br>Inner shelves: metal cutting, bending, drilling, wood cutting | Base: cutting, drilling, fastening<br><br>Wood + MDF top: selection, cutting, gluing, cutting, sanding, waxing |
| **Potential Production System** | Limited series | Made to order | Made to order | Limited series |
| **Material + Production Scalability Potential and Challenges** | **Medium**<br><br>Sourcing alternative sources of cylinder which could be potentially cut to size<br><br>CNC process possible but with channel width variability | **Low**<br><br>Ring availabilty<br><br>Availability of coats or other leather sources at a reasonable cost<br><br>Varying types of leather | **Low**<br><br>Time required to find a suitable tabletop<br><br>Need to adapt legs to existing skirt of tables<br><br>Multistep production process | **Low**<br><br>Lamp shade availability<br><br>Consistency of available wood offcuts<br><br>Wood + MDF top multistep production process |
| **Viabilty Challenges** | Utilitarian kitchen accessory for most people<br><br>Current version is small and only moderately distinctive | Current version is lacking in comfort and ergonomics<br><br>Thin gauge of leather + wrinkles undermine the chair's aesthetics | Metal legs can be less appealing for some<br><br>Tabletop is thin vs. legs<br><br>Requires more space than other dining tables due to legs | Metal base can be less appealing for some<br><br>Strength and safety issues may negate use as a stool |
| **Viabilty Enablers** | Original as an upcycled object | Art deco aesthetics<br><br>Distinctive design object | Distinctive - aligns with chubby design trend<br><br>Extendability increases capacity<br><br>Inner shelves add innovative functionality | Dual or triple purpose functionality |
| **Past Identity Salience** | Low | Medium | Low | Low |

# Takeaways

The scalability and viability of this collection was limited by several factors, and enabled in a few instances by other factors. Interrelated challenges, as well as enablers, are detailed below.

## Material Sourcing, Selection, Storage and Evaluation Challenges

- → Time constraints for material sourcing, given that prototypes needed to be ready in time for the graduate exhibition.
- → Limited available quantities of non-compliant and deadstock lighting components.
- → Limited storage space available limited the volume of material which can be gathered at the time of collection.
- → Limited window of opportunity for collecting (given manufacturer's need to clear out space) means material selections were made relatively quickly and instinctively in regards to design potential and sometimes because multiple units were available.
- → Resulting variety of material gathered proved somewhat overwhelming and evaluation was done quickly. Given time constraints, only some 30% of the different components were reused, representing 15% of the total volume of material.
- → Sourcing a table-top through classified ads was time-consuming, with limited selection, no information on the wood, and the need to go and view the table to decide.
- → New materials offer an efficient means to complete a prototype, however, the choice of thick steel for the utensil holder was not sufficiently thought through. There needs to be a clear plan from the get-go for sourcing waste materials equivalents to new materials for eventual batch production.

## Material Sourcing Enablers

- → The good variety of very finished-looking components available from Eureka Lighting was inspiring for design and efficient in terms of collecting a lot of material from a single source.

## Design and Production Process Challenges

- → A lack of information on existing material dimensions, finishes or properties.
- → The need to develop methods of accurately measuring components and setting marks for transformation.
- → The need to design and develop custom brackets and fittings.

- → Increased 3D modeling time required to determine how existing pieces can be cut and connected to make the design and assembly work with their geometries.
- → Material constraints, such as existing finishes which make certain processes impossible, require removal of the finish, or special adhesive primers before refinishing.
- → A lack of access to tools and equipment enabling precise tolerances, and limited access to metal shop and wood shop facilities due to Covid and general high demand at times.
- → Tool/equipment constraints, namely a lack of precision with the mainly manual processes of available facilities entailing production trial and error, and the need to redesign in some instances.
- → Tool/material safety issues means certain processes cannot be carried out with certain materials, such as grinding aluminum, or planing or cutting reclaimed wood, which may contain hidden pieces of nail.
- → A lack of experience in welding made this process impractical given time constraints and or need for precision.

### Production Process Enablers

- → Access to the vast experience of metal and wood shop technicians was a great help in problem solving. If one person didn't have the answer, another person often did.
- → The wood shop has recently acquired a CNC Router. If a CNC routing process can be made to work, the 40 additional units of Utensil Holder suggest some potential for scalability. However, discussions thus far with wood shop technicians raise technical issues with both reclaimed wood and lumber offcuts.

### Perceptions/User Experience Viability Challenges

- → The sensorial experience of the hard, shiny, dark anodized or powder coated components may work for a utensil holder or shelving, but is less appealing for furniture such as a chair or table, where touch and proximity play key roles.
- → Functional performance aspects like ergonomics and comfort are critical, and issues in the prototypes absolutely need to be addressed to ensure scalability in this regard.
- → The lighting components' common geometric forms and new finishes made it challenging to convey their past identity in the upcycled objects

### Perceptions/User Experience Viability Enablers

- → The shiny newness of the material countered potential perceptions of poor finish quality in upcycled products identified in previous research (Sung & Abuzeinab, 2022).
- → When the origin of the components was explained, audience interest was sparked, highlighting the role of communication in conveying a transformation story when it is less self-evident.
- → Adding wood components helped alleviate to some extent sensorial concerns with the Leggy Table (dining table) and a top of one the Side Table/Basket/Stool units, but introduced additional craft processes requiring significant additional work.
- → The addition of deadstock acoustic felt to the tops of the Side Table/Basket/Stool, Half-Moon Shelf, and 70° Table was more process efficient, however the available colours feel a bit dated, or corporate somehow.
- → The use of paint added interest to the Half-Moon Shelves and top of the 70° Table. Further colours as well as protective clear coatings would warrant research and development on finishes.

## Reflection

The material sourcing research ultimately led to a sourcing almost entirely from a single manufacturer, with a very specific type of waste stream and resulting waste materials. Despite the drawbacks of the material sourced, the results from this case as well as the small sample of other manufacturers contacted suggest the potential for sourcing reusable waste from manufacturers is very good. Construction companies seem more complicated to deal with, but they do offer potential if access and deconstruction processes can be worked out.

Clearly, the most limiting scalability factor were the limited quantities of non-compliant and deadstock material. While fashion deadstock can involve hundreds, even thousands of units, with lighting, components have much higher value, and entails, at least in the case of Eureka, more stringent product planning, and thus more limited quantities when it comes to deadstock.

As research on upcycling perceptions has indicated, aesthetics that lead to *delight* and general “wow factor” type drivers of upcycling purchases are driven by design, creativity and innovation. These attributes are present to a certain degree in the Ring Chair and Leggy Table, which particularly attracted the attention of audiences, but not so much with the initial design of other units. Resorting to additional, friendlier materials and craft techniques such as patterns to help add distinctiveness to other objects, which of course led to increased process time.

Yet, as furniture that needs to be welcomed into people's homes and lives, the pieces also have to deliver functional performance attributes such as ergonomics and comfort. In the words of Ray Eames, "What works good is better than what looks good because what works good lasts." (*Eames Design Process,* 2015, second quote*).* In this sense, positive reactions to the simply designed Half-Moon Shelves on display, while less delight-oriented, may have been more likely to lead to actual purchases. In this regard, it would have been helpful to display pricing and collect the emails of interested attendees.

Overall, the material sourcing and resulting design projects highlight the scalability and viability pitfalls of making uninformed choices. Only large volumes would allow more process efficiency, however, the objects' ability to generate interest from exhibition audiences seems directly related to their relative uniqueness, which relates to the findings of "delight" and "aesthetics" as purchase drivers.

With the 48 units of spotlight housing it could be worth working out an efficient production process for the little black Utensil Holder, providing its functional bugs can be worked out. I'm sure with some degree of craft or creative intervention, the right pricing and communications efforts, the pieces can eventually find buyers. But each intervention adds production time, and therefore affects project viability. At this point in time, the collection feels unresolved, with the balance of uniqueness, desirability, past identity salience, price and scalability remaining very elusive.

# Section 5
# Furniture and Object Upcycling Enterprise Case Studies

To dive further into the operations and success factors of upcycling enterprises, two case studies have been carried out, applying a circular business model canvas to help compare the two cases. The Studio Botté case was carried out primarily on the basis of a studio visit and in-depth interview with its founder. Maximum did not respond to email contacts, so the second case was carried out on the basis of abundantly available secondary source information, as well as the company's website and Instagram account.

## Case Study 1: Studio Botté

### Company Overview

Studio Botté is an upcycling-driven design studio established in 2018 in Montreal, Canada by industrial designer Philippe Charlebois-Gomez. As the designer-maker describes in an interview, while working as a designer for a prominent local lighting design manufacturer, he saw the potential of objects discarded in the street, decided to quit his job and design his own lighting fixtures using an upcycling approach. (A. Edwards, 2021). Today his practice is well established with a solid base of interior designers recommending him for residential and commercial projects.

### Materials and Product Range

Studio Botté's range of commercial and residential lighting work includes wall mounted, ceiling suspended, and free-standing lighting designs (Fig. 35) made from three categories of materials:

- ➔ Discarded consumer objects, including Venetian blinds, fan grills, barbecue grills, broom handles, curtain rods, ceramic objects, and parts from discarded lighting
- ➔ Decommissioned industrial and commercial lighting components
- ➔ Decommissioned street lighting globes

## Figure 35: Lighting Designs by Studio Botté

*Pajaro Del Paraiso* from Venetian blinds

*Soplo* from desk legs + clothes drying racks

*Olas* from pedestal fan grills

*Cera* from a ceramic vase

*Milhojas* from desktop file organizers

*Torre* from industrial light refractor, ceiling light canopy, steel conduits for electricity, brass tubing

All photographs by Philippe Charlebois Gomez, Studio Botté
https://www.instagram.com/studio.botte/

## Material Sourcing

The studio initially sourced all its materials from street finds. Friends and customers subsequently became an impromptu sourcing network, bringing the designer individual donations or alerting him about the whereabouts of discards, such as fan grills he uses in on-going series (P. Charlebois-Gomez, personal communication, July 15, 2022).

He also sources from municipal reuse centers, second-hand stores and online stores (A. Edwards, 2021), and according to the studio's Instagram feed, has started collaborating with architects and building tradespeople to recover materials from building demolition or refurbishment projects, such as office or industrial lighting components (Fig. 36) (Studio Botté, 2020).

Virtually all of his materials are from waste sources. The studio has been given unused surplus wiring from a lighting manufacturer. Only lightbulb sockets need to be purchased new to ensure compliance with electrical safety standards. While the studio carried out extensive material sourcing in the first years of operation, there is less need to do so these days, and its storage space is currently very full.

Figure 36: *Lighting Fixtures Recovered from Building Deconstruction Projects*

*Note:* Photographs by Philippe Charlebois Gomez, retrieved from Studio Botté Instagram account:
Left: https://www.instagram.com/p/CIjck9KH0tD/
Right: https://www.studiobotte.com/realisations

In 2021, Charlebois-Gomez recovered through a contact a batch of City of Montreal post-top type street light diffuser globes (Fig. 37) Realizing the scope of the opportunity, Charlebois-Gomez started collaborating with La Mine Urbaine, a non-profit reuse organization in the nearby suburb of Laval. As of writing, some 500 globes have now been recovered and cleaned by La Mine Urbaine, awaiting reuse projects by Studio Botté and others (P. Charlebois-Gomez, personal communications, April 17, 2023).

Figure 37: *Globes from Decommissioned City Street Lights and Subsequent Lighting Project by Studio Botté*

*Note:* Installation of street light globes and lighting design from the exhibition Surexposition: Lumière sur le Surcyclage at Le Livart, Montreal [Photographs] by Patrick Pearce, March 19, 2023

As discovered on Studio Botté's Instagram feed, the designer has transformed these 50 cm street lamp globes into attractive commercial and residential lighting projects (Fig. 38).

Figure 38: *Commercial and Residential Lighting Projects from Decommissioned Street Lamp Globes, by Studio Botté*

*Note:*
Left: Photography by Raphaël Thibodeau (n.d.) from Studio Botté website https://www.studiobotte.com/realisations
Right: Photograph by Philippe Charlebois Gomez (n.d.) from Studio Botté Instagram account: https://www.instagram.com/p/Cj_YQDgvCsX/

## Material Management

During my meeting with him, the designer explained his inventory approach (P. Charlebois-Gomez, personal communication, July 15, 2022). The studio space features 1000 square feet of storage space, which houses three categories of material:

1. Material, such as fan grills, for recurring series, i.e.: popular products
2. Material for one off projects, organized by type of material, such as tubing or ceramics (Fig. 39)
3. Material for someday/maybe projects, for which there is not yet a design

Figure 39: *Waste Materials Awaiting Projects at Studio Botté*

*Note:* Photographs by Philippe Charlebois Gomez (n.d.) from Studio Botté Instagram account

Charlebois-Gomez underlines the importance of keeping track of inventory costs, and mentioned the following formula used at his previous employer as a useful tool for attributing material storage to each piece:

monthly rent + utilities cost
÷ total square footage of storage space
x square footage that each piece occupies
x number of months before usage
= total storage cost for the piece

For example, a single piece that is stored for three years may have cost $15 in storage costs by the time it is put to use. This does count the time or costs involved in collecting and cleaning the piece.

## Design and Production Approach

Studio Botté's production is very much craft-driven and handmade by Charlebois-Gomez. One-off projects start with looking at the objects in the studio's materials area for inspiration. Given the rarity of certain pieces, the designer-maker finds it important to first sketch and then create a 3D model of each project. This also helps to reduce fabrication uncertainties with first time projects, and allows clients to get a good idea of what the finished piece will look like before it's made. Most of the designs have a sculptural aspect to them, contributing to their uniqueness. The option of custom colours adds to the design quality and appeal of his work.

Production operations typically include boring, cutting, drilling, milling, and forming. A lathe is often used during the making. Finishing involves custom colour spray painting, or for floor lamps, powder coating through for greater protection. All operations are carried out in the studio's workshop (Fig. 40) except for powder coating, which is outsourced to a local coating shop.

Figure 40: *Designer-Maker Philippe Charlebois-Gomez in the Workshop at Studio Botté*

*Note:* Photograph by Véronique Grenier (n.d.) provided by Studio Botté

Smaller fixtures may require three to four hours of work, while larger ones require eight to twelve hours over a few days, including spray painting work done in-house. Commissions involving multiple pieces can require a few weeks (P. Charlebois-Gomez, personal communication, April 17, 2023).

## Business Model

The quality of the work was noticed early on by the curators of the coveted Montreal design show Souk, which has selected Studio Botté to exhibit four times. Fueled by Instagram and word-of-mouth, the studio has developed a solid reputation within the Montreal interior design community. Some 20% of the work is for commercial projects, i.e.: cafés (Fig. 41), bars, restaurants or offices. The other 80% is residential, of which 70% comes through interior designers, and 30% through direct customer inquiries.

Figure 41: *Lighting by Studio Botté at Café Pastel Rita in Montreal*

*Note:* Photograph by Philippe Charlebois Gomez (n.d.) from Studio Botté website https://www.studiobotte.com/realisations

Prices for the pieces are quite reasonable, considering the quality and uniqueness. According to the studio's website at the time of writing, prices (in Canadian dollars) start at:

- → $500 for wall fixtures
- → $650 for suspended lights
- → $1,300 for floor lights

In terms of content creation, the designer-maker explains that he often arranges with clients to take photos of his work in its interior design setting, and while he considers

this organization and work shooting and preparing posts to be “a big time suck”, it seems to have paid off, as the studio currently has over 8,000 Instagram followers.

Although he regularly receives inquiries from abroad, Charlebois-Gomez prefers to maintain a local or regional proximity to his clientele, limiting orders to a 650 km radius within the provinces of Quebec and Ontario, and preferring direct contact with customers in the spirit of building relationships and a sense of community.

## Scalability and Growth Perspectives

Outside of some financial tasks, handled by his relationship partner Véronique Grenier, and occasional workshop and installation work, all of the work is carried by Charlebois-Gomez alone. Given this workload, especially with the high volume of orders received during the pandemic, he recognizes the risk of physical and creative burn-out. In fact he has recently decided to limit the number of projects he accepts, as the Studio Botté website states: “*Given a high demand and our desire to carefully treat each project, please note that we only take on a few orders per year. Orders are deliverable within 3 to 4 months following the reception of a deposit.”*

The designer-maker is looking to take on an apprentice to take on certain production operations, but also administration and marketing tasks. It has to be the right person with the right mix of skills and long-term collaboration potential, and given that the person would require a lot of supervision during at least the first year or so, they need to accept a minimum wage to start, so this all adds to the challenge of finding someone.

While the work is essentially hand-crafted using a one-off approach, Charlebois-Gomez sees benefits in eventually investing time to build jigs to facilitate the design of series, especially when he has an order for three or more identical pieces.

While the designer-maker would like to see the studio grow to a certain degree, he does not envision it doubling its output, for example. He does not see his work as “products,” and wants to keep it focused on craft production. So he sees significant scaling up as a risk of losing contact with the making, and diluting the vision and values of the studio. However, he wishes he would have charged higher prices to begin with, and admits he would generally like to earn a more comfortable living from the work over the long term.

# Case Study 2: Maximum

## Company Overview

Maximum is a French designer and manufacturer of furniture made using waste from industrial, commercial and government sources. The company was founded in Paris in 2014 by two design school graduates and a business school colleague. In 2019, the company purchased and moved into a 1,300 square meter historic industrial building in the suburb of Ivry-Sur-Seine, upcycling waste materials to build production and warehouse facilities, as well as offices and a showroom area within the premises. According to information available as of writing, the collective employs 12 people, upcycles over 20 tonnes of waste per year, and has recently launched a division dedicated to architecture and interior design projects (Brosseau, 2022; CONSTRUIRE, 2018; Dubois, 2023; Lalanne, 2019).

## Materials and Product Range

Maximum's catalogue spans commercial and residential applications, with seven product lines (Fig. 42):

- *Clavex* tables made from powder-coated end-of-life construction scaffolding, decommissioned architectural glass panes and synthetic cork production waste
- *Gravène* chairs made from polyethylene powder generated by production run changes, locksmithing steel tube offcuts or wine barrel production offcuts
- *Rotoman* polyethylene stools designed and produced as by-products of test samples carried out by the manufacturer for production runs
- *Bultan* sofas made from damaged crowd control barriers, non-compliant wood furniture slattes, automotive upholstery offcuts and foam offcuts
- *Bupo* desks made from decommissioned office doors
- *Airbo* shelves made from non-compliant carbon fiber honeycomb sheets from Airbus
- *Polix* luminaries made from end-of-life fluorescent tubes, polystyrene production waste, unused portions of steel sheets during cutting operations, and new LED circuitry

Figure 42: *Furniture and Lighting Designs by Maximum*

*Clavex* from scaffolding + architectural glass

*Gravêne* from polyethylene + locksmithing tubes

*Bupo* from office doors

*Airbo* from carbon fiber sheeting

*Bultan* from crowd barriers + foam + car upholstery

*Polix* from fluorescent tubes + polystyrene

All photographs by Maximum
https://www.instagram.com/maximum_officiel/

## Material Sourcing

Identifying scalability as a key metric from the get-go, the founders started by reaching out to companies to find consistent waste sources that could enable series production (Machecourt, 2022). They talked to manufacturers, but also construction companies (Fig. 43), cultural institutions and government bodies, such as local police departments, which offered crowd control barriers that were eventually used in the design of sofas. Today they work with some 20 partners supplying waste materials (Mouton, 2022).

Now that the company is somewhat known, organizations reach out to them (Brosseau, 2022), such as Centre Pompidou, which offered decommissioned sections of their iconic curved glass tunnels that house the walkways and escalators of the cultural institution.

As the company explains, when companies have to pay to dispose of their waste, they generally offer it free of charge to Maximum, which arranges transportation. In some cases, Maximum pays the wholesale cost of the raw materials used to generate the volume of waste they're recovering. With metals, there is an active resale market for waste materials, so they purchase the materials from the supplier at market prices (Brosseau, 2022).

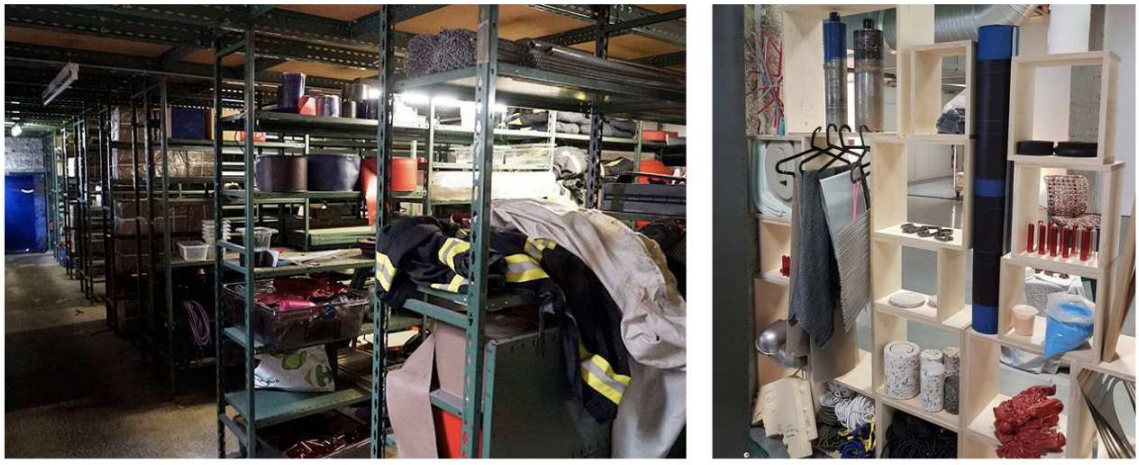
Figure 43: *End-Of-Life Fluorescent Tubes and Scaffolding From Construction Management Companies*

*Note:* Photographs by Maximum (n.d.), from Maximum Instagram account
Left: https://www.instagram.com/p/BiRE9NVDDCe/
Right: https://www.instagram.com/p/BRll67SFIiQ/

## Material Management

Material sourcing is an on-going activity, with one person dedicated to sourcing and collaborating with suppliers. Material is stored in the company's warehouse (Fig. 44, and a library of waste materials offers inspiration for the company's design team (Leleu, 2016).

Figure 44: *Waste Materials Storage and Library at Maximum*



*Note:* Photograph by Clémance Lelieu (n.d), 18h39 website https://www.18h39.fr/articles/ils-fabriquent-des-meubles-design-a-partir-de-dechets.html

## Design Approach

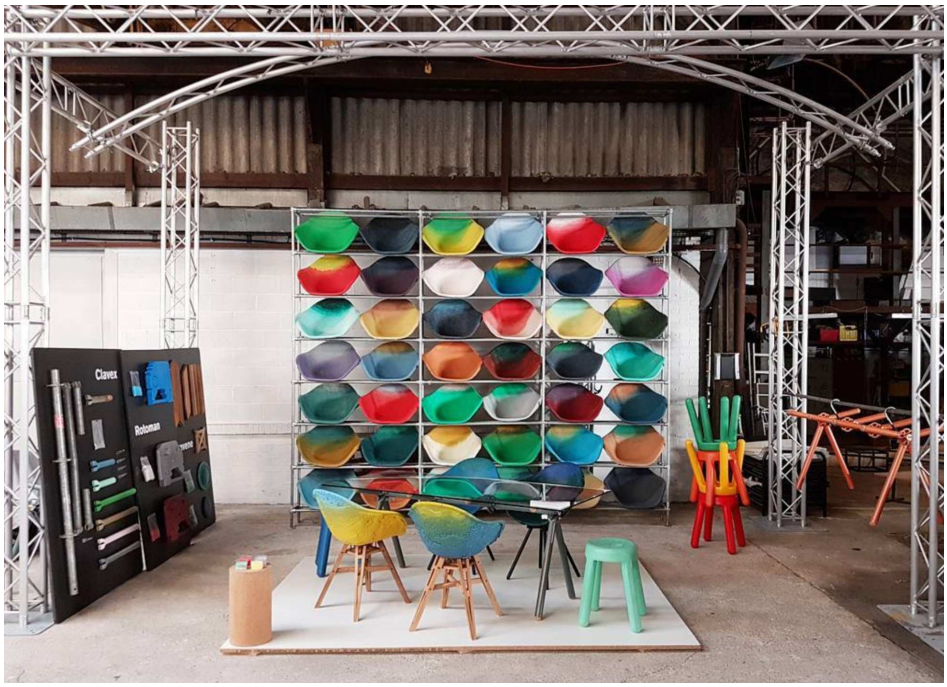
The company emphasizes their desire to recover not just raw material, but the form of products and the work that went into making them (Dubois, 2023; Le Fort, 2022). Thus creative reuse is the predominant approach in the design and material approach to their projects, however, they also embrace other forms of upcycling, such as utilizing unused polyethylene powder waste generated the production run changes of a plastic compounds manufacturer in to make their Gravène chair, or turning this same manufacturer's injection mold test samples into a functional by-product by creating a mold for small stool. For steel parts, Maximum has its supplier use space leftover on sheets used to cut out parts for other clients, according to its Instagram account.

In terms of aesthetics, Maximum's designs share a general sense of clean, modernist lines with a recurring theme of rounded forms and corners. The Gravène chair line seems directly inspired by the Eames Molded Plastic & Fiberglass Chair.

The multiple colour options of the Clavex tables, the Rotoman stool and the Gravene chairs add vibrancy to the brand's aesthetic (Fig. 45) The Gravène notably allows custom colour combinations, resulting in a variety of look & feel possibilities, from subdued to wildly colourful, as well as a choice of two models of chair form, and two

types of leg upcycled materials and two height options. The Polix luminaire can be either wall mounted or suspended. Most products are offered in different sizes, enabling more flexibility in application.

Figure 45: *Maximum's Product Showroom Highlights the Brand's Colourful Nature*




*Note:* Photograph by Maximum (n.d.), from Maximum Instagram account

## Production Approach

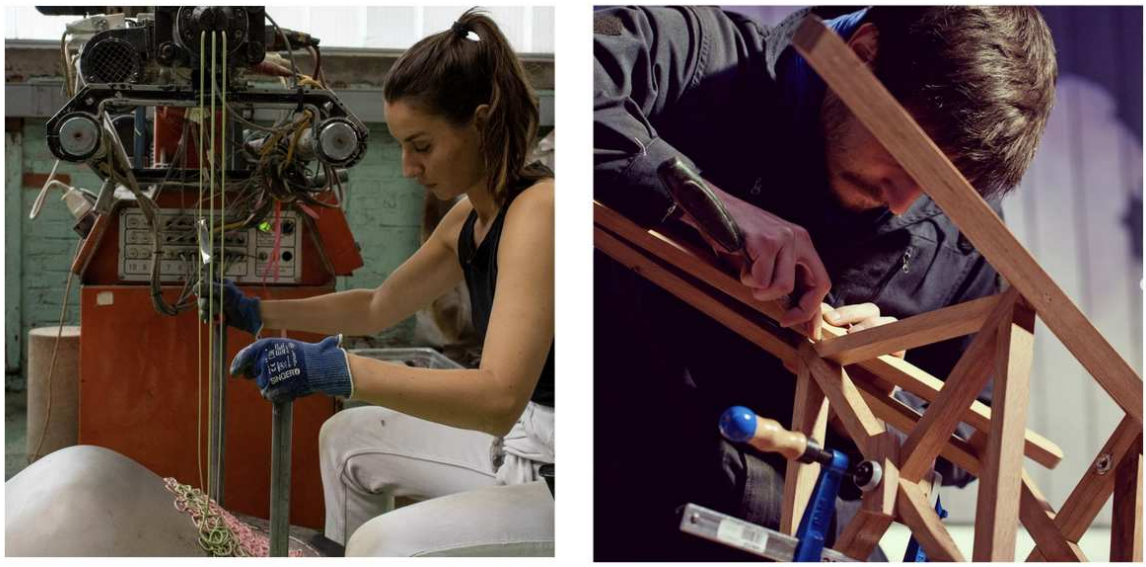
As attested by its Instagram photos and accompanying explanations, the company manages its design and almost all of its production within its own facilities. Outsourced operations include upholstery work on the sofa, plasma cutting of steel parts, and powder coating on table legs. For steel parts, the company affirms that it has its supplier use space leftover on sheets used to cut out parts for other clients. The approach for powder coating is similar: the table legs for Maximum are added on to the batches coated for other clients, suggesting that powder coating equipment set up and clean up time are associated to those projects rather than Maximum's. In terms of colours, Maximum inherits those specified by other clients (Fig. 46) however recurring orders are common in the industry, so certain colours are likely to also be recurring. From a product marketing standpoint, Maximum is able to offer several table leg colours — currently nine of them. The issue then becomes an inventory management one, with the risk being that colours that don't sell eventually need to be recoated.

Figure 46: *Table Leg Colours Vary in Function of the Powder Coater's Orders for Other Customers*

*Note:* Photograph by Maximum (n.d.), from Maximum Instagram account

As shown or explained in the company's Instagram posts in 2019, 2020 and 2021, Maximum's production facilities and equipment include workshops for plastic extrusion, woodworking and metalworking. The company has been given or has acquired old equipment such as an extruder, a lathe and a thicknesser that have required refurbishing. They adapt and create tooling for certain operations, such as a custom hydraulic press to bend crowd control barriers into the shapes required for the Bultan sofa. The processes are all carried out by hand, presumably with workers dedicated to specific tasks (Fig. 47). For the aforementioned interior design project involving glassed-in meeting rooms, the company brought in welders to produce 178 steel frames for the window panes over a three week period.

Figure 47: *Workers Carrying Out Plastic Molding and Woodwork Operations*



*Note:* Photographs by Maximum (n.d.), from Maximum Instagram account

## Business Model

Increasingly known among architects and interior designers, 80% of the company's revenues come from sales for projects involving restaurants, hotels or offices. The other 20% are sales made to consumers, either directly or through distributors (Brosseau, 2022; Le Fort, 2022). At the time of writing, Maximum lists nine retailers and galleries in France, as well as outlets in Japan, Switzerland and Lebanon. The company also invites customers to visit its showroom before buying directly via its website.

With its many customization options and circular qualities, its Gravène chair is by far the company's best seller. Notable projects include chairs for the Palais de Tokyo museum's café (Fig. 48) (Métout, 2017), and an interior office design project using the glass panels from Centre Pompidou to create circular meeting rooms (Fig. 48), as well as 1,200 chairs for the offices of the Galéries Lafayette department chain (Brosseau, 2022). The company also offers the possibility of renting its furniture for events.

Figure 48: *Gravène Chairs in the Café of the Palais de Tokyo, and an Interior Design Project Using Repurposed Glass From Centre Pompidou for Altavia Group*

*Note:* Photographs by Maximum (n.d.), from Maximum Instagram account

Maximum's founders have stated their intention to keep their prices competitive vis-à-vis competitors who manufacture in Eastern Europe (Dubois, 2023). As examples, Gravène chairs start at €210 (side chair with metal legs) while Clavez tables range from €810 (seats 6). Compared to €670 for a basic Eames chair sold by Vitra, or €48 for a similarly shaped mass market chair sold by Wayfair, Maximum's prices seem mid-range, with good value for the hand-crafted quality, although not overly comfortable in terms of margins, given fixed costs as well as all the work involved from sourcing through making, marketing and selling. Given margins earned by retailers, Maximum may well consider retail distribution more of a means of building brand visibility rather than a significant source of profits.

To underscore the waste it is saving from landfill, Maximum's product identifiers each include a number, which indicates the number of kilos of waste it has saved. So whether you order the Bultan 25 or Bultan 64, you know how much waste you have saved. As another clear signal of sustainability, the company offers an unlimited guarantee on the normal wear and tear of its products, offering to exchange or repair them as necessary, according to its website.

According to Instagram feed and the scope of its media coverage, Maximum appears to have benefited from excellent exposure across high profile events, including circular solution exhibitions starting with an order of 24 chairs for the COP21 conference in 2015, which the founders cite as key in helping them gain credibility in the marketplace (Le Fort, 2022). Other events include Change Now summits in both 2020 and 2022 (Fig. 49), and the influential design exhibition Maison & Objet, in 2019. It has also organized pop-up shops at major retailers, including Habitat and Galéries Lafayette (Fig. 49).

Figure 49: *Maximum Products at the Change Now Summit 2022, and Galéries Lafayette*


*Note:* Photographs by Maximum (n.d.), from Maximum Instagram account

The company's Instagram feed seems fairly active with content production quality good but not as consistent as it could be in terms of art direction and photographic quality, and a few of products are lacking high quality application shots. Material and process-related photos make up a significant proportion of the content, which highlights the importance of its people, and helps differentiate from other furniture makers.

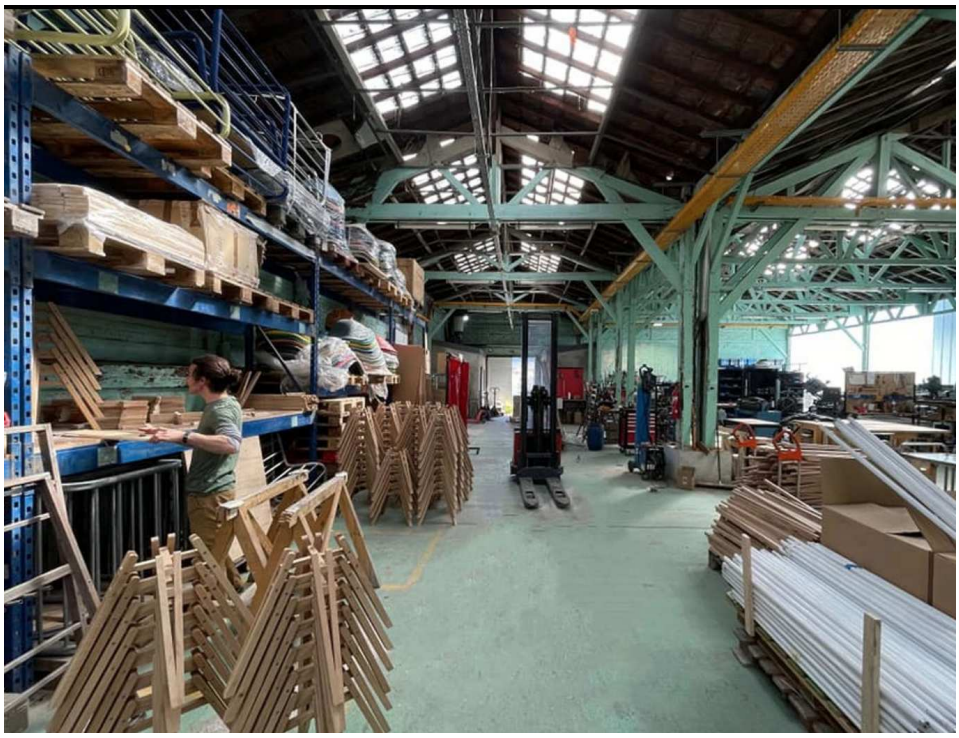
## Scalability and Growth Perspectives

The company affirms a clear intention towards series production in order to maintain viability, and is hoping its products can all be "bestsellers" in this regard (Dubois, 2023; Le Fort, 2022; Machecourt, 2022). A recent article mentions annual revenues of €700,000 and sales of some 4,000 Gravene chairs a year (Dubois, 2023), which suggests they are starting to reach a respectable level of volume, although not necessarily a comfortable income for everyone involved, considering the various costs their facilities and production entail.

Other scalability challenges for Maximum include the preponderance of manual processes involved in their current production system. Customization options also impact the scalability: as Gravène's shell, legs and colours are completely customizable, assembly can only be done to order. However, many parts can be produced in batches, such as legs for the Gravène (Fig. 50) and Clavex table, and recycled polystyrene end components for the Polix luminaire. Given its relatively compact size, the three sizes of completed Polix could be produced in batches. However, the Rotoman stool depends on the plastics manufacturer's production runs

done for its clients. The Bultan sofa requires a fair amount of storage space, so this may limit the inventory possibilities of this product.

Figure 50: *Maximum Warehouse Containing Waste Materials and Batches of Finished Components*



*Note:* Photographs by Maximum (n.d.), from Maximum Instagram account

Maximum's ability to deliver an order of 1,200 chairs, or 178 large glass partitions with welded structural frames suggests an ability to scale up as orders require. The company has indicated that it has the capacity to double its output of its star chair to 8,000 units per year (Brosseau, 2022).

This said, growth for the company may also lie in new product development. One of its designing founders has expressed an ambition to produce "several dozen products", as an outlet for the continuous waste produced across various industry sectors in France (Brosseau, 2022). With the help of a regional circular economy innovation grant, Maximum is currently working on interior design panels made from clothing fibers mixed with another, non-recyclable form of waste, which the company is keeping under wraps for the time being (Delumeau, 2022).

# Circular Business Model Canvases Compared

Business model canvases offer simple tools for examining business model components and comparing these between enterprises. The canvas proposed is an adaptation of Lewandowski's circular business model canvas (Lewandowski, 2016), with elements from the EU-funded education project Live Circular Canvas (Live Circular Canvas Consortium, 2020).

The adaptation highlights the contribution of the "design/creativity value" component of the value proposition presented in the theoretical framework, and details circular approaches, to clarify the nature of material circularity, as well as production approaches, a key to upcycling scalability. Below are the canvases for Studio Botté (Fig. 51) and Maximum (Fig. 52).

**Circular Business Model Canvases Compared**

Figure 51: *Circular Business Model Canvas for Studio Botté*

**Waste Materials**
– Consumer waste
– Decommissioned commercial + industrial lighting components
– Decommissioned street lamp globes
– Surplus wiring

**Key Sources/ Partners**
– Street finds
– Municipal reuse center
– Interior designers
– Architecture firm

**Key Resources**
– Designer-maker with industrial design training, lighting design experience and communication experience
– Partner handling accounting
– Company reputation facilitates project commissions and material sourcing
– Studio space with relatively large area for material storage

**Circular Approaches**
– Upcycling through repurposing of waste materials

**Key Activities**
– Material sourcing and recovery
– Residential and commercial lighting design, making + installation
– Shoot planning, photography + Instagram posting
– Material research & development
– Design + art event participation

**Production Approach/ Strategies**
– Made-to-order: one-off designs + recurring series
– 3D design work
– Hand-crafted, manual processes
– In-house spray paint finishing
– Occasional outsourced powder coating work
– Occasional freelance workers for larger commercial project production + installation

**Design/Creativity Value**
– Unique & limited series lighting designs made from a wide variety of local waste materials
– Artful, sculptural designs using contemporary colours
– Handmade craftsmanship + finish quality
– Custom colour option
– Interior design contract quality & professionalism
– Exclusive: limited number of orders per year

**Environmental/ Social Value**
– Almost entirely made from waste materials
– Diverts difficult to recycle materials from landfill
– Made in Montreal
– Local enterprise, limiting orders to a 650 km radius in Quebec + Ontario
– Circular design entrepreneur recognized by local media

**Customer Relationships**
– Relationships with interior designers who recommend their products to clients
– Relationships with direct customers who spread the word and pass on material finds
– Personal approach based on creating a rapport with customers
– Studio showroom open to prospective customers
– Strong Instagram following (8K)

**Communication/ Distribution Channels**
– Website
– Active Instagram presence driven by high quality application photos
– Commercial sales
– Design & art show participation
– Media coverage

**Customer Segments**
– Architects/interior designers (as specifiers)
– Cafés, restaurants + small offices with sustainable design interests
– Sustainable and or design minded consumers

**Revenue Streams**
– Residential and commercial commissions via architects/interior designers
– Residential commissions for direct customers

**Cost Structure**
– Studio rental
– Material recovery, purchase and storage costs
– Freelance skilled worker fees
– Outsourcing costs
– Equipment acquisition
– Website + communication costs
– Office and administration expenses

*Note*: Adapted from "framework for a circular business model canvas" in "Designing the Business Models for Circular Economy—Towards the Conceptual Framework" by Lewandowski, 2016, *Sustainability* 8, 1, p. 21 https://www.mdpi.com/2071-1050/8/1/43 and from "Circular Business Model Canvas" of Live Circular Canvas https://livecircularcanvas.eu/

**Circular Business Model Canvases Compared**

Figure 52: *Circular Business Model Canvas for Maximum*

| | | | | |
|---|---|---|---|---|
| **Waste Materials**<br>– Manufacturing purge waste<br>– Manufacturing offcuts<br>– Decommissioned and end-of life construction + building materials, security equipment | **Circular Approaches**<br>– Upcycling through repurposing of waste materials<br>– Direct reuse of recovered raw materials<br>– By-product synergy<br>– Production partner scheduling optimization | **Design/Creativity Value**<br>– Furniture crafted almost entirely from waste, in partnership with French industries (partners listed in product descriptions)<br>– Handmade craftsmanship and finish quality<br>– Products customizable with a range of creative colours & options<br>– Interior design contract quality & professionalism | **Customer Relationships**<br>– Relationships with interior designers who recommend their products to clients<br>– Factory showroom open to prospective customers<br>– Strong Instagram following (12K) | **Revenue Streams**<br>– Commercial sales via architects/interior designers<br>– Direct-to-consumer sales<br>– Retail sales<br>– Furniture rental<br>– Architecture/interior design & construction commissions<br>– Research & development grants |
| **Key Sources/ Partners**<br>– 20+ material partners including large manufacturers such as Airbus and A. Schulman<br>– Manufacturing partners for powder coating, laser cutting & upholstery work | **Key Activities**<br>– Material sourcing and recovery<br>– Furniture design, manufacturing & distribution<br>– Ecommerce platform management<br>– Architecture/interior design & build services<br>– Material research & development<br>– Production efficiency optimization | **Environmental/ Social Value**<br>– 20 tonnes of waste diverted per year<br>– Maintains the form and work that goes into products (vs. recycling)<br>– Made in France with local savoir-faire<br>– Ten year guarantee on products and repairs<br>– Circular startup recognized for its innovation by major international CE events | **Communication/ Distribution Channels**<br>– Ecommerce website<br>– Commercial sales<br>– Pop-up shops at major retailers<br>– Independent retailer network<br>– Active Instagram presence driven by sourcing, production, event content<br>– Consistent media coverage<br>– CE event & design show participation | **Cost Structure**<br>– Salaries + dividends<br>– Freelance skilled worker fees<br>– Outsourcing costs<br>– Material recovery, purchase + storage costs<br>– Building mortgage + interest payments<br>– Facilities overhead<br>– Equipment acquisition & refurbishing<br>– Website, ecommerce transaction fees + communication costs<br>– Office + administration expenses |
| **Key Resources**<br>– 3 founders with design, making + business skills<br>– Company reputation facilitates sourcing, equipment donations, recruitment of interns<br>– Large owned factory/ warehouse space allows flexibility<br>– Upcycling skills saves facilities & tool costs<br>– Paris suburb offers proximity to suppliers, large customer base, government support, circular and design networks & resources | **Production Approach/ Strategies**<br>– Manual processes = crafted products and quality control<br>– Customization options<br>– Integrated factory and warehouse with specialized workshops<br>– Outsourced coating & upholstery work<br>– Freelance workers for special projects | | **Customer Segments**<br>– Architects/interior designers (as specifiers)<br>– Restaurants, hotels, offices with sustainable design interests and or procurement policies<br>– Sustainable and or design minded consumers | |

*Note*: Adapted from "framework for a circular business model canvas" in "Designing the Business Models for Circular Economy—Towards the Conceptual Framework" by Lewandowski, 2016, *Sustainability* 8, 1, p. 21 https://www.mdpi.com/2071-1050/8/1/43 and from "Circular Business Model Canvas" of Live Circular Canvas https://livecircularcanvas.eu/

# Takeaways

## Material Sourcing and Partners

→ Both enterprises have organized their own material sourcing networks, which helps ensure the stability of their supply chains.

→ Maximum's broad approach to material circularity beyond creative reuse opens up a wide range of waste material and ways of sourcing it.

→ Maximum benefits from association with large enterprises with name recognition, such as Airbus, which helps to build their credibility as a circular manufacturer.

→ Studio Botté benefits from the cleaning and storage capacity of the material reuse center they collaborate with for the street lamp globes.

## Design and Production

→ Quality craftsmanship is a common design value component of the two firms' value propositions

→ Studio Botté's upcycling approach exclusively based on creative reuse, mostly from consumer waste, gives its work greater past identity salience and creates a delightful waste to object story. Its recent work with street lamp globes gives the resulting lighting designs a connection to City of Montreal heritage.

→ Maximum's more diversified approach to material circularity opens up a broader range of design and production possibilities, which makes its best-seller, the Gravène chair, more abstract in its transformation story, but still generally supportive of its message of making good use of waste from French industry.

→ Both firms offer colour options for products, with Studio Botté offering custom colours (which is less costly with spray painting for lighting than with powder coating for furniture), helping to reinforce object uniqueness and increasing their eligibility for professional interior design projects.

→ Studio Botté's made-to-order approach essentially results in one-off production even though some designs are recurring series. The exception is commercial commissions that involve several units. This approach means it does not have to deal with inventory, and, combined with a limited number of orders they take on, preserves the unique character and value of each piece it creates.

→ Maximum's product-driven batch approach, facilities and team means production of given components can be divided among factory zones, employees and interns for greater efficiency within the predominantly manual process approach, which maintains the relatively unique and crafted feel of most of its products.

## Customer Segments, Relationships and Revenue Streams

- → Both firms seem to have developed a certain reputation among architects and interior designers, leading to commission projects, which in Maximum's case can sometimes result in hundreds of chairs.
- → Besides residential customers, the work of both firms have attracted café/restaurant clients as well as offices, with the scale of commissions typically in line with the production capacity of each enterprise.
- → Maximum's architecture/interior design and construction division adds a revenue stream that could become important as the team wins contracts and builds its portfolio in this regard.
- → Their research grant enables Maximum to access money and time to support research and development activities on a material, which could become an intermediate use product for interior design and construction, i.e.: a potential future revenue stream.

## Environmental/Social Value

- → Both firms have been recognized in the media as innovative circular design entrepreneurs. With its larger products and production volume, Maximum is able to claim some 20 tonnes of waste diverted per year.
- → Both firms benefit from the positive aura of "produced locally".
- → Benefitting from their near-Paris location, Maximum has been invited to take part in international CE events.

## Communication and Distribution Channels

- → Maximum's product and batch production approach is supported by ecommerce capability and retail sales in addition to commercial sales, whereas Studio Botté's website functions essentially as a simple showcase for its work.
- → Both firms have strong Instagram presences. Studio Botté's well-staged, high quality application photos reinforce its design professionalism, while Maximum's focus on content related to material sourcing and the role of its team in production processes help drive follower engagement in their story.
- → Both firms have showcased their work at design shows, helping to fuel word-of-mouth and media coverage.

# Reflection

While both work with waste, the premises and perspectives of these two enterprises are very different. Within a typology of craft entrepreneurs coming out of recent study (Smagina et al., 2021), Studio Botté founder Charlebois-Gomez fits very much with the conception of an "artistic entrepreneur," valuing creative freedom and defining success on the basis of his personal aesthetic and entrepreneurial vision. Maximum's founders lean towards the "production entrepreneur," oriented towards business efficiency, revenue generation and scalability in collaboration with industry partners. These categories are not mutually exclusive; and the two companies would find affinities in each of these conceptions (along with a third category of the typology, "eco-entrepreneurs," with sustainability-related values and aspirations.) Yet there remains a clear distinction between the visions and trajectories of the two firms.

For Studio Botté, a part-time apprentice would enable a more efficient product perspective with their recurring product series. This would involve producing jigs to facilitate production, and building up a certain amount of product stock (or key components) to be able to respond quickly to order requests. A proportion could be painted in attractive "stock colours", with custom colours available for an additional cost, or colours could be kept entirely custom, requiring, say, a week to process an order rather than three or four months. The rest of the production could remain made-to-order, with the apprentice helping more as they gain experience and autonomy.

Economies of scope rather than scale imply diversifying your product range while leveraging the human and technical resources you have at hand (Cusumano, 1992). Our upcycling-oriented designers can tap into their waste material knowledge and experience, their design and engineering knowhow, their equipment, as well as the availability and knowledge of their team and or collaborators. This approach makes sense as long as it does not reduce the efficiency of production in regards to current offerings. Of course, new offerings require research and development time and testing in the marketplace before they can be successful and pay off, so scope economies can represent a gamble in this regard for micro and small enterprises.

Maximum benefits from having two designers and a business entrepreneur among its founders as well as young designers among the production interns and workers. They have a wide variety of facilities at their disposal that can be used in many different ways, and, potentially, access to further research development grants for new materials. For Studio Botté, training an apprentice requires a lot of time and supervision, and thus taking on an apprentice would only "pay off" in terms of efficiency gains after six months or more. However, an apprentice would eventually allow Charlebois-Gomez time to plan and create new objects using the studio's resources to potentially diversify the studio's work within or potentially beyond the

lighting category. This path forward may be narrower and more incremental than that of Maximum, but aligns with the founder's vision.

In terms of circular approaches, Studio Botté's work to date has been exclusively in the vein of repurposing, i.e.: creative reuse. Maintaining this purist perspective potentially limits the material possibilities in designing certain types of objects, however it ensures the salience of his object's past identities and their storytelling power, positioning the studio as a pioneering and creative upcycling designer in its market.

Conversely, Maximum's more diverse circular practices in regards to waste makes products like their Gravène chair (which seems to account for the bulk of their revenues) somewhat more abstract in terms of a waste-to-product transformation story. However, this diversity in regards to reuse approaches allows the founders more latitude in expanding their economies of scope with new products, and helps to position Maximum more broadly as an innovative and dynamic circular design manufacturer in its market.

# Section 6
# A Comparative Analysis of Upcycled Furniture and Object Projects

To further understand the scalability potential of upcycling projects, this comparative analysis proposes to examine the question across a range of upcycled furniture and object projects and the approaches of the enterprises behind them.

In line with my own design practice and upcycling focus, selections of projects have been made, with a few exceptions, on the basis of these criteria:

- → Upcycling using a creative reuse approach
- → Projects driven by design in the sense of process and form
- → Projects that convey a feeling of quality and craftsmanship

To allow comparative analysis, five items have been selected for each of the four categories, namely chairs, small tables, lighting, and bags. The latter differs in that it is not related to furniture or interior design, but is interesting to include in that it opens up perspectives on scalability. The selections also aim to present a variety of materials, aesthetics, design and production approaches.

The tables on the following pages present the reviews for the four categories, with information for each object gathered from company websites, media coverage, and email exchanges with the designers or other company representatives. Scalability for each object has been subjectively evaluated as “low”, “medium” or “high,” with comments explaining each assessment.

The tables (8, 9, 10, 11) are followed by takeaways in terms of good practices for material sourcing, production, distribution and communications.

Table 8: *Upcycled Chair Comparative Analysis*

| |  |  |  |  |  |
|---|---|---|---|---|---|
| **Designer** | Amber Lasciak | Tatiane Freitas | Enrique Kahle | Tobias Juretzek | Alex Gregg |
| **Company / Brand** | Redu Studios | Tatiane Freitas | Dvelas | Studio Nito for Casamania | Bike Furniture Design |
| **Series/Object Name** | Flootsie Chair | My Old New Series | Trimmer Chair | Rememberme Chair | S-2 Barstool |
| **Price** | USD $1,600 | Unknown | USD $606 | USD $2105 | USD $600 |
| **Waste Material** | Frame: scrap metal. Interior upholstery: yoga mats, jute coffee bags. Fabric: deadstock | Discarded and broken chairs | Decommissioned sails | Discarded clothing | Rims and other bicycle parts:<br>used + discontinued + warranty returned |
| **Waste Source** | Construction waste, donations, local coffee distributors | Street discards<br>Antique dealers | Sail-makers<br>Individual donations<br>Sailing clubs | Individual donations<br>Recycling networks | Local bike shops<br>Individual donations<br>Ebay |
| **Waste Incidence** | Periodic | Intermittent | Seasonal | On demand | Regular |
| **Uniformity** | Medium | Low | Medium | Low | Medium |
| **Additional Materials** | Piping, thread, zippers | Recycled acrylic sheeting | Steel tubes<br>Rope<br>Hardware | Resin<br>Fasteners | New upholstery materials<br>Fasteners |
| **Design & Production Approach** | Metal cutting, welding and grinding, interior upholstery material cleaning and cutting, fabric cutting and sewing, assembly | Creative repair<br><br>Cutting parts in acrylic, shaping them to form<br><br>Gluing acrylic parts in place + reinforcing wood joints | Sail cleaning, cutting, sewing to patterns<br><br>Steel tube cutting, bending, welding and powder-coating<br><br>Rope cutting, assembly, knotting<br><br>Special editions with different sails | Positioning clothing in molds, preparing and pouring resin, cleaning parts, assembly<br><br>Option of using customer's own clothing as material | Part cleaning and categorization<br><br>Cutting, bending, welding, upholstery work, assembly<br><br>Custom upholstery and rim options |
| **Current Production System** | One-off | Limited series of one-offs | Small batches + made-to- order | Made-to- order<br>Limited series | Made-to- order |
| **Material + Production Scalability Potential and Challenges** | **Medium**<br><br>Metal bar availabilty<br><br>Labour intensity | **Medium**<br><br>Sourcing<br>Multiple chair types<br>Custom parts | **High**<br><br>Material transport logistics + costs | **Medium**<br><br>Labour intensive, slow process | **Medium**<br><br>Sourcing increasingly rare used chrome rims and bike parts |
| **Viability Challenges** | Fairly high price for no fabric or colour options. Wide footprint requires large living room area. | Self-distribution | White material shows dirt easily. Less on sails available in other colours. | High price<br><br>Chair comfort? | Self-distribution<br><br>Heavy to ship |
| **Viability Enablers** | Bold and elegant unique design<br><br>Made almost entirely from waste materials | Unique design fueling visibility<br><br>Art gallery shows help create awareness | Original design in a category with low innovation<br><br>Community of interest with sailing enthusiasts<br><br>White works in many outdoor settings<br><br>Distribution through Architonic and 34 retailers worldwide | Unique design fueling storytelling<br><br>Personalization option<br><br>Mold to form chair parts<br><br>Distribution through a retailer | Community of interest among bike and motorcycle enthusiasts |
| **Past Identity Salience** | Low | High | Medium - in function of sail markings | High | High |

## Table 9: *Upcycled Small Table Comparative Analysis*

| |  |  |  |  |  |
|---|---|---|---|---|---|
| **Designer(s)** | Rupert Herring | Edelman New York | Verena Stella Gompf<br>Cordula Kehrer | Saruta Kiatparkpoom | Niels van den Honert |
| **Company / Brand** | Rupert Herring | Edelman New York | Gompf + Kehrer | Pin Metal Art | Gym & Classics |
| **Series/Object Name** | Eking It Out | I-Beam Console Sofa Table | Paper Table | Paan Table | Tokyo '64 |
| **Price** | NZD $3,700 | USD $2,500 | EUR €350 | Unknown | EUR €1,800 |
| **Waste Material** | Discarded table legs, balustrades | 30" tall I-beam offcuts | Misprint and surplus posters on card- board substrate | Metal offcuts | Decommissioned gym floorboards and gymnastics equipment |
| **Waste Source** | Street finds | Highrise, platform and bridge projects construction sites<br><br>Construction material resellers | Print shops in Vietnam | Door and window manufacturer owned by the family | Gym associations<br>Municipalities<br>Individuals<br>Manufacturers |
| **Waste Incidence** | Sporadic | Regular | Regular | Continuous | Sporadic |
| **Uniformity** | Low | High | Medium | High | High |
| **Additional Materials** | Adhesive | – | Glass tabletop | New glass top | Steel tubes |
| **Design & Production Approach** | Cleaning cutting and sanding table legs<br><br>Positioning and gluing<br><br>Finishing | I-beam offcut<br><br>Cutting, grinding, polishing<br><br>Option of polished or natural rust finish | Outsourced to a fairtrade cooperative in Vietnam<br><br>Poster cleaning and categorization<br><br>Cutting to shape, assembly and gluing | Separation of offcuts into usable sections, TIG welding | Floorboard sections cutting and varnishing<br><br>Steel tube cutting, welding + powder-coating<br><br>Customization options |
| **Current Production System** | Made-to- order | Made-to-order | Limited series | Limited series<br>Made-to-order | Showpieces<br>Made-to-order |
| **Material + Production Scalability Potential and Challenges** | **Low**<br><br>Sourcing<br><br>Labour intensive | **Medium**<br><br>Material access and or cost<br><br>Material storage | **High**<br><br>Labour intensive | **Low**<br><br>Master level of welding skill required<br><br>Labour intensive | **Medium**<br><br>Sourcing gym flooring |
| **Viability Challenges** | Impractical in terms of table ergonomics<br><br>Heavy weight makes shipping expensive | Heavy weight makes shipping expensive<br><br>Difficult to move without professionals | Distance makes shipping expensive and impacts sustainability | Self-distribution | Large size make shipping expensive |
| **Viability Enablers** | Unique design<br><br>Work shown in galleries | Unique design<br><br>Simple production process | Unique design<br><br>Low cost of labour | Unique design<br><br>Offcuts produced by company owned by same family | Relative simplicity of process<br><br>Nostalgia for school gymnasiums |
| **Past Identity Salience** | High | High | Medium<br>(easier up close than on a website) | Low | Medium to High depending on court markings or not |

Table 10: *Upcycled Lighting Comparative Analysis*

| |  |  |  |  |  |
|---|---|---|---|---|---|
| **Designer(s)** | Stuart Haygarth | Michael Konstantin Wolke | Mark Howells | Nutcreatives | Christopher Berry |
| **Company / Brand** | Stuart Haygarth | Herrwolke | Anti | Lucirmás | Factory Twenty One |
| **Series/Object Name** | Tide | Beute | Desk Lamp | Laflor Lamp | Pallet Pendant Shade |
| **Price** | £10,000-£15,000 | €380 | £160 | €205 | £45 |
| **Waste Material** | Plastic debris | Used cardboard packaging | Discarded & lost umbrellas | Used wine bottles | Used shipping pallets |
| **Waste Source** | Coastline pollution | Commercial waste | Street finds<br>Lost & found services | Consumer waste | Commercial and industrial areas |
| **Waste Incidence** | Regular | Constant | Regular | Constant | Constant |
| **Uniformity** | Low | Medium to High | Medium | Medium to high | High |
| **Additional Materials** | MDF<br>Lamp socket, wire, mounting plate | Lamp socket, wire, mounting plate | Recycled plastic<br>Lamp socket, wire<br>Steel bracket, thumb screw, slicone feet | Copper shade<br>Lamp socket, wire, mounting plate | Binding cord<br>Lamp socket, wire, mounting plate |
| **Design & Production Approach** | Objects collection<br><br>Washing<br><br>Categorization and selection<br><br>Lighting assembly, positioning objects | Cardboard cutting, separating layers<br><br>Positioning cardboard shades and graphics<br><br>Gluing<br><br>Assembly | Umbrellas dismantling, categorization, cutting parts<br><br>3D printing lampshades + base support, cleaning, painting<br><br>Assembly | Wine bottle cutting, grinding, polishing, painting, baking<br><br>Cutting copper, grinding, spin forming<br><br>Assembly<br><br>4 colours for bottle + matching wire | Pallets cutting, routing and sanding<br><br>Shade painting<br><br>2 shade sizes<br>5 shade colours<br>6 cord colours |
| **Current Production System** | Limited series of 10 + one-off commissions | Small batches and made to order | Small to medium batches | Small batches | Small batches<br><br>Shade and cord colour options |
| **Material + Production Scalability Potential and Challenges** | **Low**<br><br>Labour intensity | **Low**<br><br>Labour intensity | **Medium**<br><br>High cost of 3D printing parts using recycled materials | **High**<br><br>Multistep process requiring access to specialized equipment | **Medium** |
| **Viability Challenges** | High value — notably through art auctions | Labour intensity<br><br>Cardboard lamps have become very commonplace<br><br>High price compared to most others | Self-distribution<br><br>Cost of 3D printing with recycled plastic | Heavier than many small pendant lamps to ship | Somewhat rustic aesthetic is less popular than it once was<br><br>Weight of wood for shipping |
| **Viability Enablers** | Art galleries and auctions give the work visibility | Light weight for shipping | 3D printed parts allow faster assembly | Design with broad appeal<br><br>Sold through several retailers | Flat pack shipping<br><br>Colour options |
| **Past Identity Salience** | High | High | Medium | Medium | Low |

## Table 11: *Upcycled Bag Comparative Analysis*

| |  |  |  |  |  |
|---|---|---|---|---|---|
| **Designer(s)** | Sven Schlegel | James Henrit | Salty Bag | Alchemy Goods | Freitag |
| **Company / Brand** | Mariclaro | Elvis & Kresse | Salty Bag | Alchemy Goods | Freitag |
| **Series/Object Name** | Weekender - Purple Wow Airbus 321 | Weekend Bag | Octapodaki | Brooklyn Backpack | F306 Hazzard |
| **Price** | CAD $279 | GPB £310 | EUR €114 | USD $132 | CHF 325 |
| **Waste Material** | Decommisioned aircraft seat leather and seatbelts | Decommissioned fire hoses & parachutes<br>Leather offcuts<br>Event banner | Decommissioned sails | Used bicycle inner tubes | 76% upcycled/ recycled: Decommis-sioned truck tarpaulin post-consumer PET bottles, B-stock car seat belt |
| **Waste Sources** | Aircraft seats and seatbelts | London Fire Brigade<br>Military supplier<br>Burberry workshop<br>Auction house | Sail-makers<br>Clubs<br>Individual donations | Network of bicycle stores with innertube donation boxes | Truck companies<br>Recycled fabric co.<br>Seat belt suppliers |
| **Waste Incidence** | Periodic | Regular | Regular | Regular | Regular |
| **Uniformity** | Medium (colour variations) | High | High (Dacron) | High | Medium (truck tarp colours and designs) |
| **Additional Materials** | Zipper | Zipper<br>Steel hardware | Gromets<br>Natural hemp and jute ropes from ethical sources | Nylon<br>Foam padding<br>Zipper<br>Nylon hardware | Webbing, piping, foam, velcro fastener, tension buckle, zipper, thread, 25% recycled PVC label |
| **Design & Production Approach** | From one batch of leather, several one-off pieces of different styles of bags are made over a period of time | Made in UK + outsourced to fairtrade manufacturer in Turkey<br><br>Firehoses and other materials cleaned, cut and sewn into bags | Cleaning and cutting material<br><br>Cutting and sewing to pattern, assembly<br><br>2 colour options | Inner tube cleaning and cutting<br><br>Cutting and sewing to pattern, assembly<br><br>Zipper colour options | 30 bag designs.<br><br>Truck spotting, tarp removal + testing, disassembly, washing, drying, bag design, outsourced sewing, quality control, photography, shipping |
| **Current Production System** | One-off editions using recurring patterns | Small batch | Small batches | Small batches | On-going batch production |
| **Material + Production Scalability Potential and Challenges** | **Medium**<br><br>Limited amount of leather from a given source<br><br>Process and labour intensity | **Medium**<br><br>Craft processes and labour intensity limit ability to ensure items are always in stock | **High**<br><br>Corfu island is not home to many sail boats, so this may complicate material supply | **High**<br><br>Labour intensity | **High**<br><br>Process and labour intensity |
| **Viability Challenges** | Self-distribution<br><br>Certain colours have broader appeal than others | Self-distribution + independent stockists, mainly in the UK | Self-distribution<br><br>Dirt shows more on white bags | Self-distribution | Cost of fair wages in Switzerland and other EU counties + high value of Swiss franc = high prices<br><br>Many competitors making cheaper bags from similar material |
| **Viability Enablers** | Exclusiveness of one-off editions | Relative uniqueness of fire hose as a material<br><br>Established sustainable luxury brand reputation<br><br>Affordable prices for luxury quality<br><br>50% of profits donated to charities | Relatively light materials reduces shipping costs | Self-distribution + etailers including Amazon + wholesale through 37 retailers<br><br>Offers co-branded and private label corporate orders with a minimum of 50 units | Iconic sustainable bag brand/ independent Swiss brand<br><br>Certifed "Advanced" sustainable company across its operations |
| **Past Identity Salience** | Medium - aircraft or car seat buckles | High - fire hose markings | Medium - sail markings and stains | High - from the feel | Medium to high depending on designs + material wear |

# Good Practices

Based on my experience as a designer-maker and entrepreneur exploring upcycling enablers and challenges, my background in communications, and the case studies in the preceding section, I've identified the following "good practices."

## Material Sourcing Practices

### Material Source Incidence, Reliability and Accessibility

Figure 57: *Alchemy Goods Inner-Tube Collection Bin in a Bike Shop*


*Note* : [Video screenshot] by Alchemy Goods: https://www.youtube.com/watch?v=P2RJREdobHU

- Consider establishing your own sourcing network, such as bike shops for inner tubes (Fig. 57) or sailmakers and sailing clubs for sails, offering communication materials to encourage donations and a logistics system for recovery.
- Consider materials that are abundantly available, such as wine bottles or pallets.
- Consider materials that can be easily sourced on a regular basis from reliable sources, such as poster misprints from printers, or umbrellas from lost & found services in museums, train stations and the like.
- Consider materials with short commercial lifespans, such as event banners or vinyl advertising posters.
- Consider materials with high standards of quality and performance leading to decommissioning on a regular basis, such as sails, fire hoses, parachutes, or business class passenger blankets.
- Consider the future availability of the material to avoid problems such as chrome bike parts being phased out of production over more modern materials

### Material Circularity Value, Impact and Costs

- → Consider materials that are difficult to recycle, such as umbrellas or fire hoses, or ones where there is currently very little demand for recycling, such as textiles, glass or plastics — these materials underscore the circular value and positive environmental impact of your project
- → Consider material transportation and storage resources, costs and environmental impact. For example, large sails weigh 400 to 600 kg and require a platform truck to move, and sources may be located far from production location.

### Material Impact on Production

- → Consider time and costs required to prepare material preparation for upcycling, such as cleaning, repair, disassembly and cutting to sizes manageable for production.
- → Consider material form variability, and how easily your production can adapt to it, such as different bicycle rim types, sail materials, or umbrella types.
- → Consider materials whose form is already interesting so it requires minimal transformation. The I-Beam console table is one example, but there are no doubt others with a near “ready made” quality.

### Material Impact on Distribution and Marketing

- → Consider a material that comes with a built-in community of interest, such as biking, sailing or classic car enthusiasts
- → Consider past identity salience of the material and how this helps product uniqueness and communication, such as through material markings or otherwise.
- → Consider the appeal of colours and compatibility with customers’ existing decor, such as outdoor chairs mainly using white Dacron sails.
- → To create limited series consider materials that can be found in multiple variations, such as vinyl truck siding or advertising posters, or aircraft seat leather
- → To create a sense of exclusiveness within limited series, consider materials from rare sources. Marieclaro uses aircraft seat leather, but also creates more exclusive designs with leather from prestigious brands of vintage cars, enabling them to command higher prices for those series.
- → Consider the possibility of customers contributing materials for the ultimate personalized product, such as with Studio Nito’s Rememberme chair.

## Design Practices

Figure 58: *Past Identity Conveyed Through Product Design and Merchandising*


*Note* : From the brand's Instagram accounts: https://www.instagram.com/p/CUhfYu2o30h/

- To highlight the past identity, incorporate information about the product's origins into the design of the product or its merchandising, like Salty Bag and Mariclaro do in different ways. (Fig. 58) Salty Bag's numbers on its hang tags allow customers to find on its website information on this particular sail's type, geographic origins and where it was sailed.
- Select a product category where design innovation is low in general, and where there is not a lot of companies offering upcycled designs, such as Dvelas does with its outdoor furniture, whose design has likely helped it find distributors worldwide
- Leverage material differences (specific pieces, colours, patterns, etc.) so that each product produced appears unique, while working with the same design templates to ensure scalability.
- Create limited series from more rare versions of the material as Dvelas does for the legs of its special edition Trimmer chair made from a black carbon fiber sail, or by combining materials, like Elvis and Kresse's Fire and Hide series combining fire hose with leather offcuts from Burberry.

## Production Practices

Figure 59: *3D Printed Parts Highlighted in Anti's Lamps Made from Umbrellas*


*Note :* [Screenshot] from Anti's website: https://www.anti-waste.com/innovation/

- → Consider having parts custom made to increase production efficiency, such as Anti does with its 3D parts printed from recycled plastic (Fig. 59).
- → Consider transformation processes that are relatively common, and that potentially require lower investments in equipment, such as sewing
- → Consider the cost of owning or accessing specialized equipment for core production or finishing, such as powder coating equipment, or an enamelling kiln
- → Use jigs, molds and patterns to increase production efficiency on recurring processes
- → Consider having equipment custom made or adapted to increase the efficiency of difficult processes.
- → Consider outsourcing supply to a fairtrade manufacturer in a region in your country or internationally where cost of labour is cheaper (taking into account shipping and customs tariffs, as Gompf+Kehrer does with its tables.

## Distribution Practices

Figure 60: *Corporate Orders of Alchemy Goods Products*


*Note:* from Alchemy Goods Instagram account: https://www.instagram.com/p/CLcQo4oAIj6/ and affiliated company Ecologic Designs website: https://www.ecologicdesigns.com/work/

- → Consider accepting corporate orders branded with companies' own brands to help scale up production and revenues (Fig. 60).
- → If product design and production allows, ship your products in flat packs to reduce shipping costs.
- → If your margins allow, focus on building a network of retailers, as Dvelas does for its outdoor furniture, and Alchemy does for its bags.
- → If your project is very artful, consider art galleries as a means of distribution, as does Tatiane Freitas with her chairs, Rupert Herring with his tables, and Stuart Haygarth with his lighting projects.
- → To create a sense of exclusivity on your online store, offer only one unit of each design using a given material at any given time. This approach is commonly used by bag companies such as Freitag with its bags made of truck banners.

## Communication Practices

Figure 61: *Instagram Posts Celebrating the Past Lives of Material*


*Note:* From Instagram accounts of Dvelas: https://www.instagram.com/p/CGBJ-3ipU2X/ and Bike Furniture: https://www.instagram.com/p/BNztIQRhWy0/

- → Celebrate the past identity of materials with photos that show these past lives in context, as does Dvelas and Bike Furniture Design (Fig. 61)
- → Justify high prices by presenting the labour-intensiveness of the production process in a transparent way, as does Freitag (Budgen, 2017).
- → Create videos and share them on your website, or via Youtube or Instagram to explain the ethos and or process behind the making of your product as do Lucirmás, Alchemy Goods, Elvis & Kresse and Salty Bag.
- → Detail use of materials both waste and new throughout the product as does Anti on its website to underscore its sustainability in a transparent way.
- → Show the material sourcing process, such as Mariclaro's salvaging of seat materials from old cars, or Gym & Classics recovering floorboards from a gym renovation.
- → Celebrate the craftspeople and craftsmanship that goes into making the products, as do Elvis & Kresse, and Pin Metal Art.
- → Collaborate with customers and friends to plan and shoot beautiful photos of products in their use context, as Alchemy Goods does with its bags, and Studio Botté does with its residential and commercial lighting.
- → If you are considering a highly competitive market like bags and your margins allow, consider investing in an intensive content strategy to build your following continuously and keep your brand in followers' feeds, as well as targeted online advertising to build awareness and increase conversion, as does Alchemy Goods.

# Reflection

Waste material availability is the first key factor, and materials like cardboard packaging, wine bottles, clothing, and pallets are great choices in this regard. Building a material network enables regular or at least periodic access to sizable quantities of materials like sails, posters, inner tubes, umbrellas, fire hoses, aircraft seats and passenger blankets. Gymnasium flooring, chair and table components are more sporadic. More complicated is Stuart Haygarth's highly selective approach to coastline debris, which, according to his website, requires years of him walking to gather the right pieces for a project. Chrome rims and components, once common, are now rare, forcing bike furniture designer Andy Gregg to supplement donations and finds by purchasing used parts on platforms like eBay (A. Gregg, personal communications, April 7, 2023).

The second potential production scalability factor is process, and the simpler the better. Edelman New York's console table made from a huge I-beam is exemplary in this regard: you simply cut it (although this does require a serious cutting tool or two), grind the edges smooth and apply a clear coat if the customer so desires. Simple bag designs can be produced efficiently using simple cut and sew processes, such as Salty Bag's two-tone navy hold-all. Anti's use of 3D printed parts is a good example of using technology to increase efficiency, helping to connect a variety of umbrella parts to keep total production time to two to three hours per lamp (M. Howells, personal communications, April 13, 2023).

Craft production techniques are a defining characteristic of upcycling based on creative reuse or creative refurbishing. Among businesses that have grown from micro to small enterprises, Elvis and Kresse reports that working with fire hose is so laborious and difficult, they were unable to find enough people in the UK who could do the work to their quality standards, and have opted to open their second workshop in Turkey where there is a strong tradition of leathercraft. Gompf+Kehrer's tables, requiring hours of cutting, gluing and finishing, are outsourced to a fairtrade cooperative in Vietnam. Freitag similarly outsources sewing work to European countries where labour is less expensive than Switzerland. International production outsourcing impacts the sustainability of the products, but seems a necessary tradeoff to ensure a certain level of scale given the nature of these projects.

As discussed in the section on perceptions, upcycled products trade on design, creativity and innovation — all elements that contribute to their perceived uniqueness. This value proposition leads upcyclers to behave like many other designer-makers of unique craft objects. These have been found to typically use low-volume local and artisan production methods to create high margin products appealing to niche customer segments and sold via narrow distribution channels like direct online sales, local retailers, or specialized ecommerce platforms (Doussard et al., 2018). The upcycling comparative analysis confirms these patterns.

The projects reviewed highlight some ways of pulling off this balancing act: leverage unique variations in materials like sails, or truck tarpaulins (Fig. 62), access rare sources like car seat leathers, combine materials like fire hose and leather — all while using recurring designs, patterns and jigs. While not as unique, offering custom colours, or at least several standard colours, also supports design/creativity value, as well as competitiveness in terms of enabling customers to find what they are looking for.

Fig. 62: *Using Truck Tarpaulin Patterns to Create Unique Bags at Freitag*

Note : Photo credit: Joël Tettamanti, retrieved from Freitag website: https://media.freitag.ch/sites/default/files/freitag_impact_en.pdf

Upcycled products are generally expensive, making them luxury items for many people. The I-Beam console, though relatively simple to produce, is likely expensive to transport from its material source, and at USD $2,500 plus shipping to destination, the price tag limits sales. Freitag is arguably the most successful upcycled object enterprise with 250 employees and 320 retailers worldwide. Its bags retail from CHF120 (CAD $177) for a simple shopping-sized tote bag, to CHF325 (CAD $480) for a 19 litre backpack. Why? High wage costs in Switzerland and the value of its franc are partly to blame, but the main issue, according to founder Daniel Freitag, is the labour intensity involved in its 15 step process, and its principle of paying all its employees and partners fair wages (Pavarini, 2017).

# Section 7
# A Strategic Design Process for Upcycling

As the culmination of this research creation project, this section proposes a process for planning, designing and developing upcycled projects. The very idea of such a process runs counter to the often spontaneous and creative nature of most upcycling projects. So why a process? The primary aim is to reduce the failure rate of upcycling design projects. Many projects discovered during the comparative review phase seemed to have high potential and a great design, yet were no longer available. Of course in some cases, the project's founder may have simply decided to move on to other projects, but in others, there may well have been problems with material or its source, design, production, or business aspects. This process aims to help designers anticipate these problems and make more informed decisions with a broader perspective of the stakes, issues and opportunities to be considered. Consistent with the preceding chapters, operational scalability and business viability are key touchstones for the process, and while it has been conceived with furniture and objects in mind, it can work for other types of design projects as well.

## Basis for the Process

This process has been developed on the basis of the following sources:

- → Learnings from the furniture and object upcycling case studies and design review presented in previous sections
- → Learning from the author's upcycling design practice, also presented in this thesis.
- → Upcycling-related design processes presented in the theoretical framework section. Notably, architecture researcher Hanna Jörlen's "Means-Inspired Design" process for building material reuse in architecture projects (Jörlén, 2020), which was too detailed to show, has particularly inspired the visual schematic design of the process that follows.

While the Double-Diamond phases of "Discovery, Define, Develop and Deliver" are inherent in any reuse or Means-Oriented Design-style process, these have not been explicitly identified in this process, as the process cycles too often back and forth between the phases for these to be truly useful as framework.

## Strategic Considerations in Process Design

The process is based on three key considerations:

### Project Premises as Starting Point

While the vast majority of upcycling projects likely start from found material, this process supposes more intentionality in the aims of the upcycling designer, and therefore starts with premises in terms of the basic design and business aspects of the project. This provides some framework for selecting material and sources, and these can then be subjected to more rigorous evaluation to assess its suitability for the project's scalability and viability. If an upcycler already has a material they are keen on, they can of course start from later on in the process.

### Business Aspects are Key to Viability

The process includes steps related to business modeling and planning. Researchers have found that strategic planning activities are directly related to performance among entrepreneurs (Jr et al., 2018; Kraus et al., 2008; Saah, 2022), and craft businesses (Makhitha, 2016). In the spirit of the "lean startup", planning can be done on the back of a napkin, however, it has also been found that degree of formalization in business planning is key to entrepreneurial success (Greene & Hopp, 2017; Liao & Gartner, 2007; Olson & Bokor, 1995; Zhang et. al., 2013; as cited in Müller et al., 2023). While many designer-makers likely create something first and then start tackling the business aspects, this process proposes to integrate business planning into the design development process to potentially save time and effort, i.e.: to help avoid some of the problems I faced with the development of my pieces.

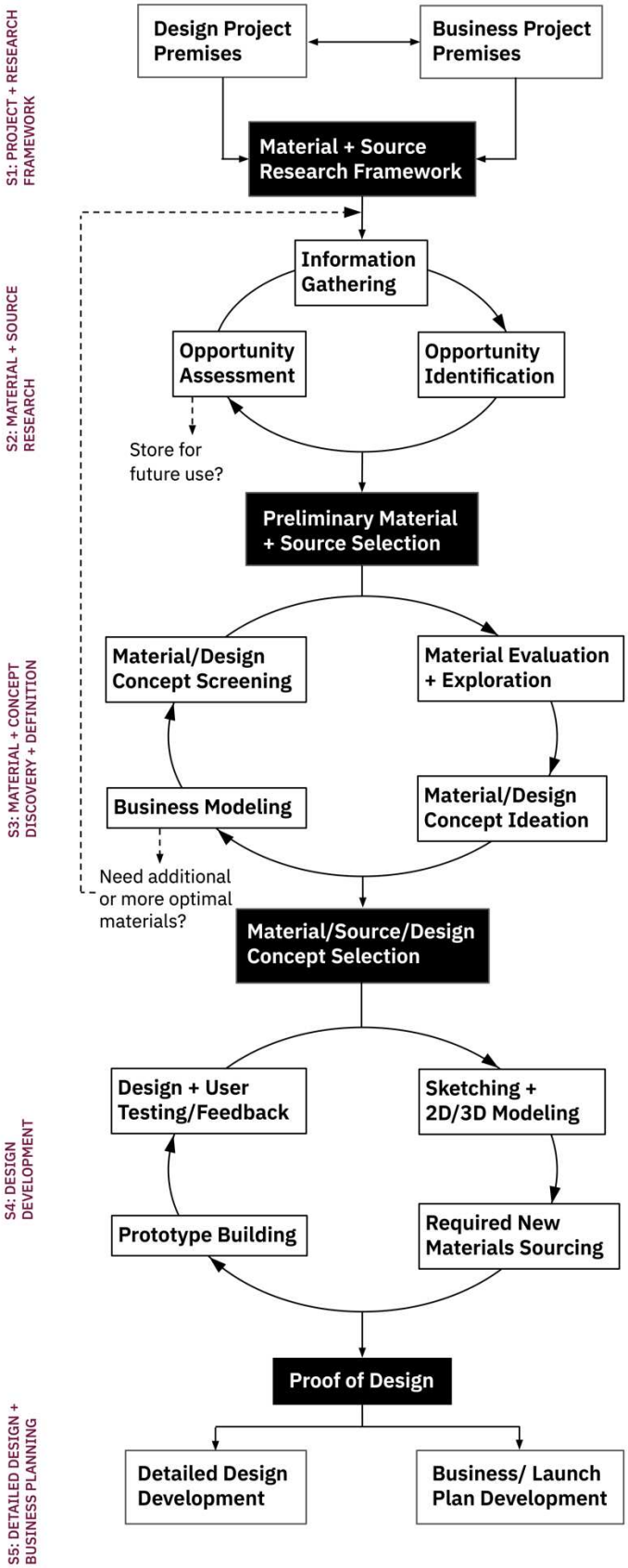
### Iterations Can Lead to Better Outcomes

The design process proposes circular process loops for *Stage 2 - Material and Source Research*, *Stage 3 - Material and Concept Discovery and Definition*, and *Stage 4 - Design Development*. The loops imply that a designer can go through the steps once (as quickly as they like), or continue to cycle through the steps of these stages until a robust or at least a satisfactory outcome has been arrived at. For example, a given waste material or object can suggest an immediate new purpose, or going through the steps of Material and Concept Discovery and Definition can well lead to additional purposes, in juxtaposition with other materials, which may prove more compelling to users, most cost effective, etc. So the process is designed to encourage optimization, but the actual nature and scope of activities and tasks carried out at each step depend entirely on the person carrying out the project, their goals, the project's scope, and how granular they want to get.

## Process Presentation

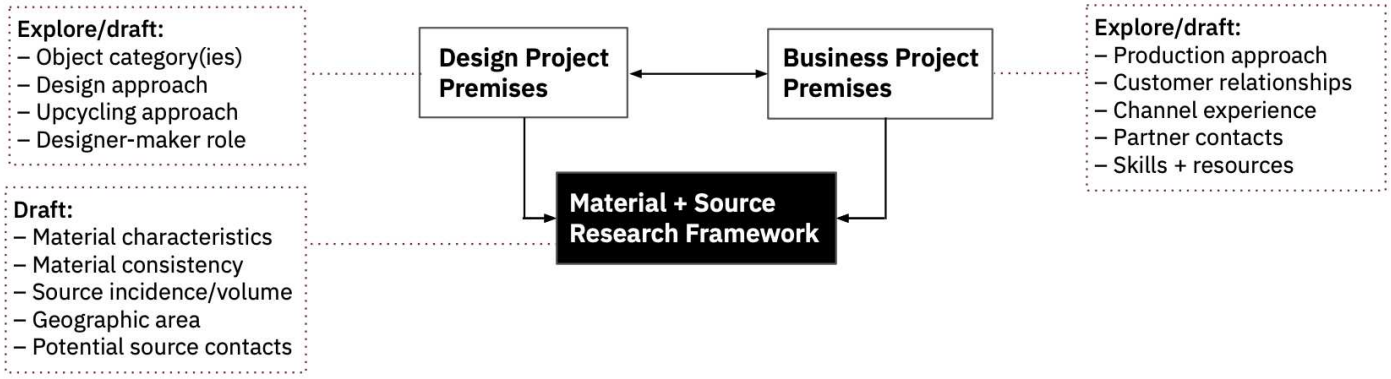
The following pages show the overview of main stages and steps (Fig. 64) followed by a section-by-section explanation of how each stage can be approached in terms of goals, tools and methods, and outcomes (Fig. 65-69), followed by the detailed schematic overview (Fig. 70).

Figure 64: *Strategic Design Process for Upcycling - Overview*



# Stage 1: Project and Research Framework

Figure 65: *Stage 1: Project and Research Framework Process*




## Stage 1 Process

### Goal

Establish clear (or at least loose) starting points for researching and evaluating material opportunities.

### Tools/Methods

- → Self-questioning
- → Brainstorming
- → Notepad
- → Online map
- → Linkedin, emails and other personal contact databases

### Outcomes

A rough draft of your upcycling project premises from a design and business standpoint.

### Notes

The project starts with some kind of vision: what kind of upcycling project the designer might want to do, their role in the process, and what kind of production and business this could entail. The business premises help define the possibilities of what can be achieved based on what and who the person knows, and what means they have at their disposal to help. These starting points then allow the person to sketch a research framework, which will be refined as they start considering possibilities.

## Stage 1 Questions

### Design Project Premise

→ Design project type: functional design, urban design, art project, participative design, co-design, etc.?

→ Object/application category(ies): which one(s) is/are the designer interested in creating?

→ Upcycling approach(es): repurposing, refurbishing, upgraded recycling or other?

→ Designer role: design only, solo production, with an assistant or a team?

### Business Project Premises

→ Production approach: one-off, a limited series, or batch production, in-house or outsourced?

→ Customer relationships: what relationships with potential audiences do they have, such as an Instagram following or a connection to a community of interest?

→ Channel experience: what experience do they have with which communication and distribution channels?

→ Partner contacts: what contacts do they have for material sourcing, production, financing?

→ Skills: what design, production, management, communication and sales skills do they possess?

→ Resources: what production facilities, human resources and financial resources can they access?

### Material + Source Research Framework

→ Material characteristics: what aspects structure, form, strength, aesthetics, etc. are needed to fit the object categories of interest?

→ Material consistency: how consistent does it need from one piece to the next in terms of form, quality, etc. to fit with the production approach?

→ Source volume and incidence: what kind of volume is needed and how often?

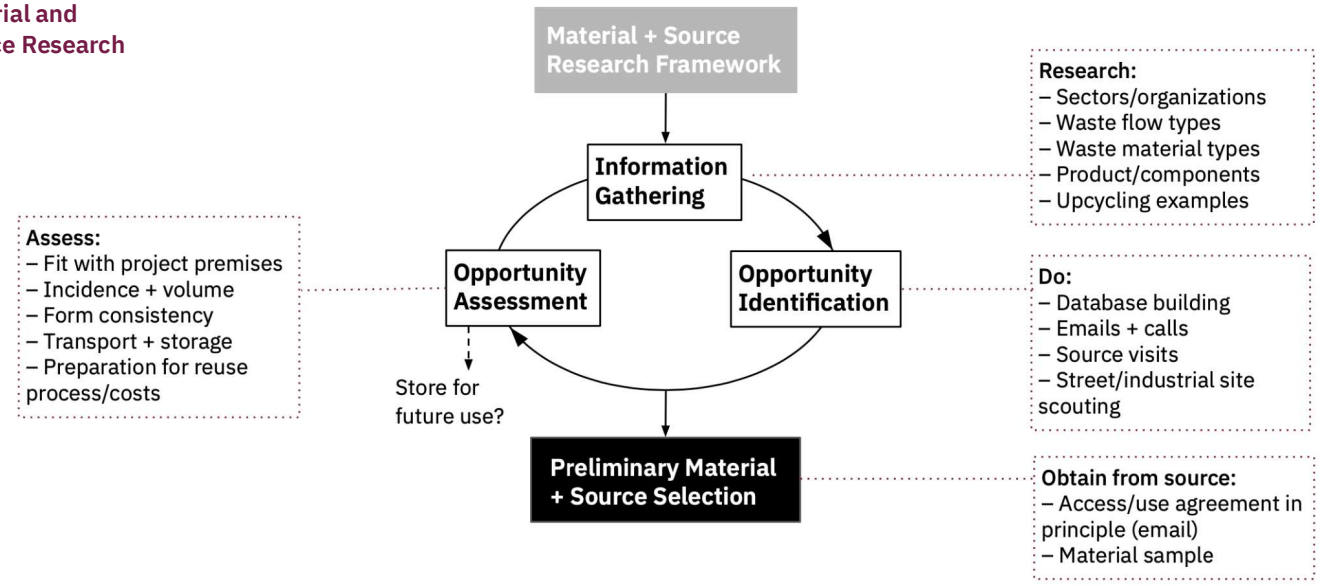
→ Geographic scope: what travel distance around the likely place of production makes sense in terms of material sourcing?

→ Potential source contacts: what helpful source contact information can be accessed?

→ Timeframe: is there a timeframe for arriving at a preliminary material and source selection?

# Stage 2: Material and Source Research

Figure 66: *Stage 2: Material and Source Research Process*




## Stage 2 Process

### Goal

Identify material opportunities that offer a preliminary fit with the research framework, design and business project premises.

### Tools/Methods

- → Spreadsheet or other software to build a database
- → Government or other industrial sector databases on materials and manufacturers
- → General Internet research
- → Exploratory street and or industrial site scouting for street/industrial finds
- → Linkedin Sales Navigator to find contacts
- → RocketReach to find emails
- → Emails and calls to reach specific contacts or at least company general inquiries
- → Source visits to assess material, take photos and gather samples
- → Informal use agreement (an email should suffice at this point)

### Outcomes

A preliminary selection of material and sources.

### Notes

*If you already have access to a source of seemingly wonderful material*, you are a lucky upcycler, and can jump right away to the Preliminary Material + Source Selection stage. Simply obtain a sample and start evaluating it with the step of Stage 3.

For the rest of us, the existential question is: what objects or materials, from what source types and what waste streams, can fit the material and source framework, design and project premises? To help with this serious puzzler, the presentation of data types and related questions below offer different types of starting points for the research.

## Stage 2 Data Points for Information Gathering

### Waste Sources

Manufacturing/industrial
Business/commercial
Construction/demolition
Government/institutional consumer
Material reuse centers
Material resale vendors

### Waste Materials

Finished products
Intermediate goods
Components
Raw materials
Packaging

### Waste Streams

Excess/surplus/deadstock
Non-compliant/flawed
Offcuts/scrap/remnants
Trimmings
Test waste/samples
Purge/cleanout waste
End-of-life
Out-of-date
No longer needed/loved

## Stage 2 Questions for Information Gathering

### Manufactured Objects and Material Starting Points

- → What finished consumer, business or industrial objects might offer an interesting fit with the project premises?
- → What intermediate-use objects or materials might offer an interesting fit?
- → What upcycled objects have been made from these objects or materials?
- → What kinds of sectors and manufacturers are producing these objects or materials?
- → What kinds of distributors are distributing them?
- → What kinds of organizations are purchasing and using these objects or materials?

## Stage 2 Questions for Information Gathering (con't)

### Source Starting Points

Manufacturing/Industry Sectors:

- What manufacturing/industry sectors are present in the region?
- What types of finished and intermediate use products do they produce?
- Who purchases and uses them?

Business/Commercial Sectors:

- What medium and large service enterprises are in the region? (Think companies that provide services in person, such as hospitality, transportation, etc.)
- What medium and large commercial distribution or retail enterprises are in the region?
- What types of finished and intermediate use products do they distribute or use?
- What types of solid waste do they produce?

Government/Institutional Sectors:

- What city or other governmental departments could be generating interesting waste?
- What educational, healthcare, research or cultural institutions are in the region?
- What types of finished and intermediate use products do they use?
- What types of solid waste do they produce?
- What elements of infrastructure are being decommissioned these days?

## Stage 2 Questions for Opportunity Identification

- Who is responsible for sustainability practices for the organization?
- Who is responsible for sustainability practices for the organization?
- What material recovery and waste management practices are used by the organization?
- What waste streams and materials does the organization generate?
- What data is there on incidence and volume of the materials?
- Can photos of the material be taken and shared?
- How can access to materials be arranged?

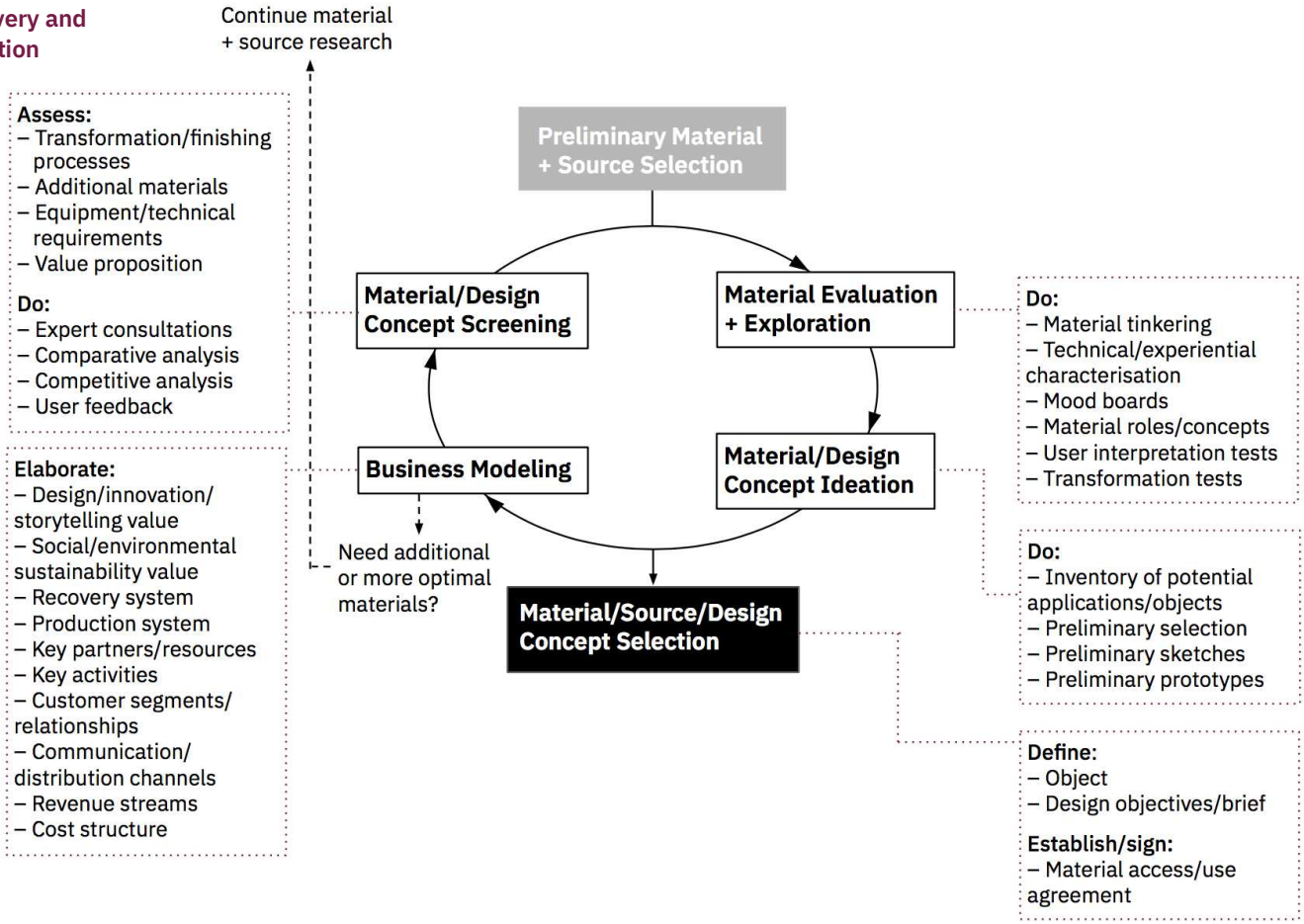
## Stage 2 Questions for Opportunity Assessment

- → How can access to materials be arranged?
- → How well do the material characteristics fit with the design and business premises?
- → What is the source's incidence and volume of the material?
- → How consistent is the material form?
- → What are the logistics and costs of transporting and storing the material?
- → What would be the process and costs required to prepare the material for reuse?

# Stage 3: Material and Concept Discovery and Definition



Figure 67: *Stage 3: Material and Concept Discovery and Definition Process*




## Stage 3 Process

### Goal

Carry out an iterative discovery and definition process in regards to material affordances, design concepts and corresponding business models

### Tools/Methods

- → Material-Driven Design methods
- → Brainstorming and object inventories
- → Internet research
- → Sketching
- → Preliminary 3D modeling

- → Rapid prototyping
- → Business modeling
- → Production process analysis
- → Expert consultations
- → User testing
- → A formal use agreement detailing the products or materials, the general purpose they may or will be used for, the volume and access, transportation.

### Outcomes

A selection of material(s), source(s), and definition of the upcycling design object, its business model draft, and design brief.

### Notes

If the material has inspired a very clear design concept from the start, this process can be potentially quick, and focused on developing the business model, and validating the design and business concept.

The level of detail of the business model at this point depends on the clarity of the design concept, and may feel very presumptuous until you have a functional prototype. Never-the-less, the business modeling exercise can be relatively efficient and valuable in validating whether or not a design idea is worth investing time and money to develop. Among key questions, does the designer-maker have (or can they get access to) the skills and resources to produce the object, and is the estimated price people would be willing to pay likely to cover all the costs, with enough room for a reasonable profit?

At this point, the designer may find that the material does not have the potential they initially expected. Or that it has high potential, but requires additional material to result in an optimal design. In either case, they need to return stage 2, material and source research. In practice, stage 2 research may continue in parallel for certain materials and sources while stage 3 discovery is happening.

## Stage 3 Questions

### Material Evaluation and Exploration

- → What are the physical properties of this material?
- → What feelings and sensations does it elicit on its own or in combination with other materials?
- → What conceptual roles can it play from a design and experience standpoint
- → How do users interpret these possibilities
- → How can the material be transformed in simple or complex ways?
- → Can it work as the main material for an object or application, or does it really require others to balance it out?

### Material/Design Concept Ideation

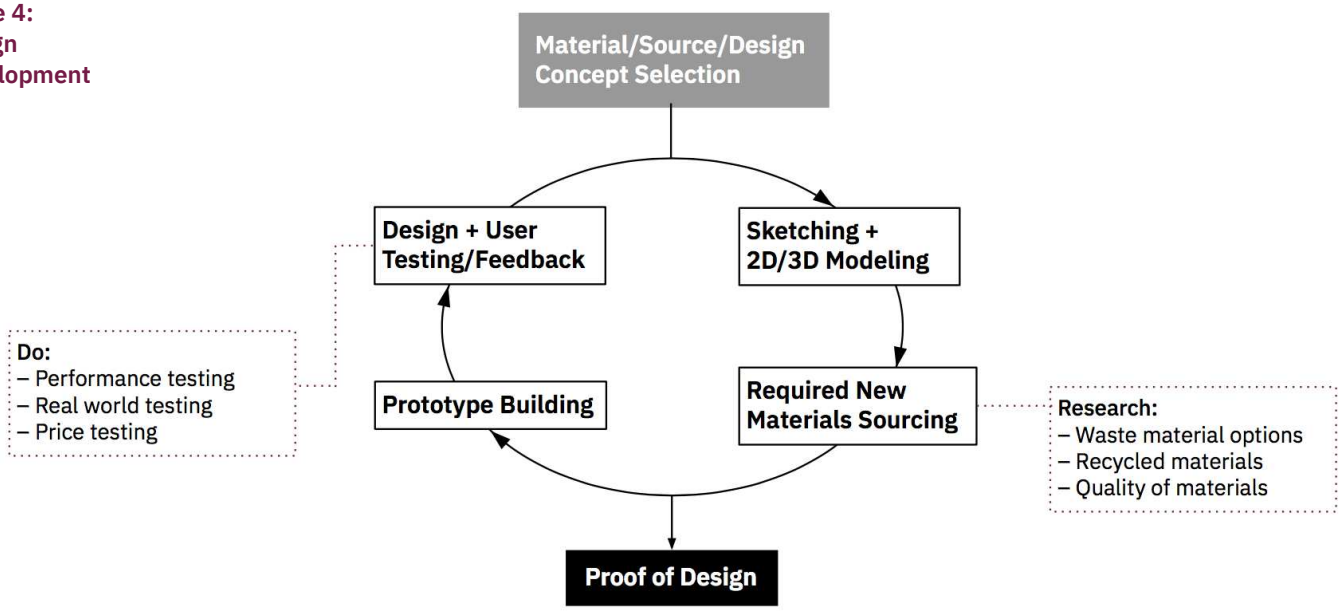
- → What applications and objects can be possibly designed from this material?
- → Which ones have the best design potential?
- → What other waste or new materials would be required?

### Business Modeling

- → How can the object's value proposition be defined in terms of design, creativity and innovation?
- → How recognizable would the material's past identity be? How can this help storytelling?
- → What's would be the material recovery and storage system?
- → What would be the production system, strategy and processes?
- → What types of people would be interested in purchasing the object?
- → What connections do you have with these audiences?
- → What functional and aesthetic criteria would they consider?
- → How much would they be willing to pay?
- → What communication and distribution channels and efforts are required to give the object the visibility and market reach it would need?
- → What are the rough costs of material sourcing, storage, preparation for reuse, additional materials, production, packaging, distribution and communication?

# Stage 4: Design Development

Figure 68: *Stage 4: Design Development Process*




## Stage 4 Process

### Goal

Develop the design concept into a fully functional pre-production prototype that works from a performance, user and business case standpoint

### Tools/Methods

- → Sketching
- → 2D and 3D modeling
- → Supplier research for additional materials
- → Prototype building and finishing
- → Outsource supplier research
- → Functional performance testing
- → Durability testing
- → Real world testing
- → User testing of features and pricing

### Outcomes

Validated design and business model.

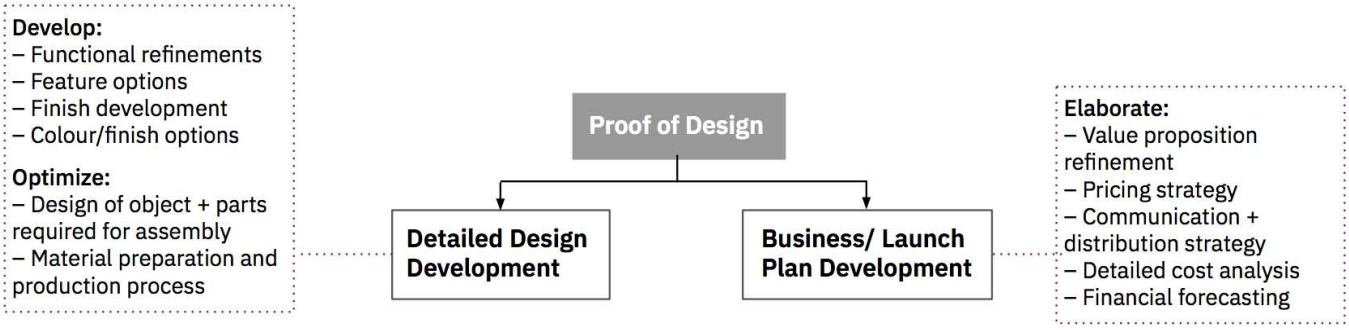
### Notes

This stage is where you figure out how to actually make the object. Production processes initially envisioned may well change during this stage. While working through development, the designer-maker needs to think about how the operations can be made more efficient for actual production. Updated estimates of labour requirements, outsourcing costs if certain aspects need to be outsourced, and additional material costs along with price ranges resulting from user testing need to be fed into the business model's assumptions to ensure it is still valid.

# Stage 5: Detailed Design and Business Planning



Figure 69: *Stage 5: Detailed Design and Business Planning Process*




## Stage 5 Process

### Goals

- → Further develop and optimize the design for production
- → Elaborate business plan components and launch/go-to-market plan

### Tools/Methods

- → Prototype development/refinement
- → Colour and finish research
- → Outsource supplier research
- → Request for Quotes
- → Production process analysis
- → Distributor/agent/retailer research
- → Marketing and communication planning
- → Cost analysis
- → Financial forecasts

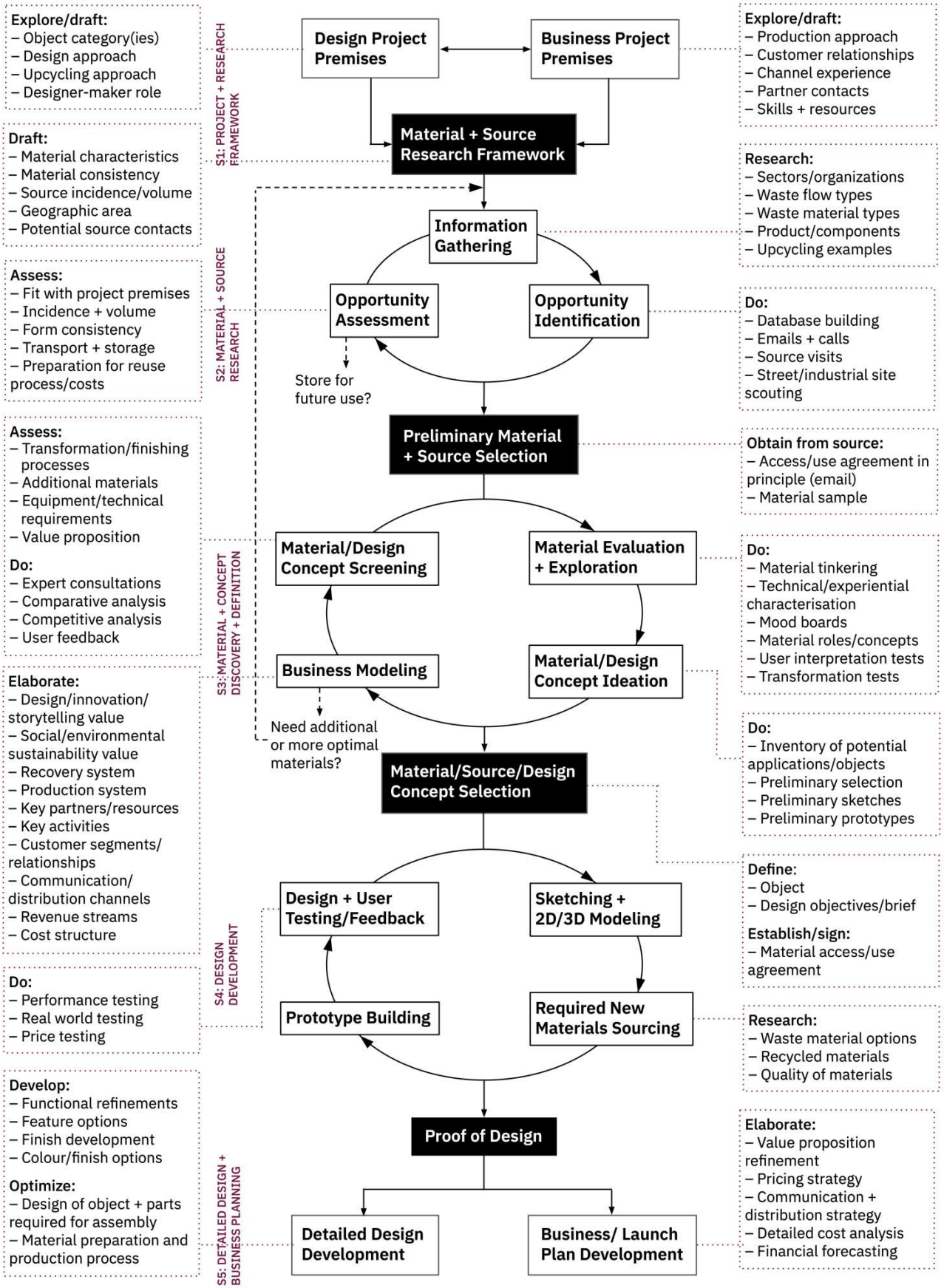
### Outcomes

A production-ready prototype, business plan, and launch plan.

### Notes

Stage 5 is about finalizing and optimizing the design for production, and the business plan for commercialization and launch of the object. This involves diving into the fine details of the design, its features and options, as well as production and distribution processes and hard numbers for given quantities of scale.

Figure 70: *Strategic Design Process for Upcycling - Complete Process*



# Reflection

Of course, one process does not fit all, and this detailed “strategic process” will seem like overkill for some. And yet all of the issues raised in the process come out at some point in an upcycling project or another, intuitively, in discussions, or through problems that arise. The circular loops of research, discovery, development and evaluation/definition can be as quick or as drawn out as desired. The thoroughness of these processes and robustness of outcomes also depend on the stakes of the project and the person driving it. A backyard garden planter is probably quite different from a set of planters for a fancy restaurant.

The process helps avoid potential pitfalls by vetting ideas at two key moments. First of all, during Stage 2’s Opportunity Assessment step, where both the source and material are evaluated for fit with project premises and production scalability goals. Secondly, during Stage 3, where ideas are subject to the more in-depth Business Modeling and Material/Design Concept Screening steps.

In her thesis on Rematerial-Oriented Design, de Castro Pereira finds material reuse to be an “unpredictable and non-linear activity” whereby material can be integrated in the design process at different stages depending on the situation of the project or the stage of design (2017). Jörén talks in her Means-Inspired Design thesis model about setbacks leading to revisiting previous stages (2020). My utensil holder project is a good example of this non-linearity, where the stage 4 prototype is now in limbo, and awaiting for stage 2 research to start again to arrive at a new source of waste material that can work with a production-efficient process. In this case, the role of the material and its objectives become very precise, and once found, the process may well be able to skip stage 3 and jump right away back into stage 4 prototyping.

De Castro Pereira notes that “goal construction” and “materialization” are key moments in the process, and that goal construction may continue throughout the project, while materialization usually happens only once goals have been clearly decided upon (2017). The designer may have a very clear object in mind, such as, say, a chair. However their material and source research may not be resulting in materials with a strong fit with the project’s design and business premises. Eventually they may have to decide: forgo the project timeline so material research can continue, or switch to another object altogether, or at least in the meantime. Then again, a material find can trigger a wild new design idea that changes the entire project — a classic moment where the means can truly orient the design.

# Section 8
# Discussion and Conclusions

Through the literature review, design practice work, design review and case studies conducted, this research-creation project has led to several findings with useful contributions to both theoretical and practice-related knowledge of upcycling scalability and viability. The research-creation components have been driven by the following research question and sub-question:

*How can upcycling-oriented furniture and object designers improve their design process, from sourcing materials to production, in order to help scale up their operations and increase material circularity?*

*What practices can help upcycling-oriented furniture and object designers arrive at a viable enterprise?*

## Research Topic

The literature review demonstrates how upcycling adds value to objects through design, sustainability, ethics and storytelling, and how creative reuse increases design and storytelling value more than other forms of upcycling due to the more transformative nature of the process. The subsequent research-creation methods employed address research gaps in the topic in several ways. The design-practice component shows how specific material and design choices directly affect scalability and viability for the designer-maker. The two upcycling enterprise case studies add to the few others that go into some depth through comprehensive circular business case analyses of material choices, production operations, distribution channels, and communications. The comparative analysis of furniture and object projects enables comparison of scalability and viability challenges and enablers within and across object categories. The resulting insights then substantiate factors to consider in the proposed upcycling design process, distinctive in its detailed, and practical tool approach to both the design and business challenges of upcycled objects. In general, this research project sheds light on many aspects of furniture and object upcycling from a designer perspective.

## Manufacturing as a Source of Material

Although very small in sample size, primary research carried out among manufacturers to identify waste material opportunities for upcycling appears to be original in its cross-sector approach and reuse focus. The results from the eight local manufacturers

suggest the manufacturing sector has excellent potential as a source for various types of reusable waste material.

Waste streams related to on-going production operations such as scrap, offcuts and trimmings are logically more regular in their incidence, and are thus beneficial for scalability. Non-compliant material can be limited to a few batches, but as the carbon fiber flooring from Airbus recovered by Maximum suggests, the incidence of defects can also be on-going and result in waste with high reuse potential. The classification of an inventory of finished products or components as unsellable deadstock typically occurs at a given point in time, however, such stock can warrant consideration if the quantities are large enough quantities, or if a limited series fits with the designer's upcycling project vision.

In terms of process, the material-source discovery matrix employed helped to map out possibilities of sectors, organization types, manufactured product types and corresponding materials as the potential means to produce a wish list of objects. Yet the organization contacting process underscored the value of contacts to jumpstart actual access to waste materials owned by these organizations.

### Situatedness Sets the Agenda

The broad differences in the two furniture and object upcycling enterprises underscore the fact that scaling up depends first and foremost on the founders' vision of themselves, their work and their role in its production, as well as the resources at their disposal — in other words their situatedness as designer-makers and entrepreneurs within their respective contexts (Rohlfing et al., 2003).

Situatedness clearly influences the material inclinations of designers like avid cyclist Andy Gregg, and sailing enthusiast Enrique Kahle. Being situated in London makes umbrellas a perfect material for lighting designer Mark Howell. In a broader perspective, the fact that Markus and Daniel Freitag are cyclists means that all of Freitag's bag designs are designed to work for cyclists, and the company has consistently cultivated strong ties to the community.

Situatedness also informs my work in my personal desire to explore unique designs and craft interventions to the point that some of these were clearly not viable. Part of my context in this regard was to create objects I would want to integrate in my home — I'm thinking of the dining table in particular. So my situatedness hasn't helped me thus far in regards to scaling up.

## Material Sourcing and Production System Drive Production Scalability

From the designer-maker's point of view, the first part of scaling up upcycling is the physical and technical ability to do so. This essentially involves two key components: material source and production processes. In regards to material, the two cases and many of the design review objects dovetail with the findings of Kyungeun et al. in terms of the effective use of material sourcing partnerships, which ensures the reliability and efficiency of waste material to work with. My design projects offer a counter-example in that my source of deadstock and non-compliant material was inherently limited. Thus the Upcycling Design Process for Objects sets up a project's given waste incidence and volume conditions from the start.

On a production level, Anti's 3D printed parts facilitate assembly, and with sufficiently strong materials, 3D printing could also streamline bracket fabrication and simplify assembly for my Leggy Table, Side Table/Basket/Stool, and 70° Table. In addition to Anti, Maximum's by-product creation, which involves zero work apart from the initial mold, and their cost-saving collaboration with suppliers to optimize material use and production set-up time, also dovetail with the idea of production innovation for competitive advantage (Sung and Abuzeinab, 2021; Singh et al., 2019, as cited in Kyungeun et al., 2022).

More broadly, having access to a pool of qualified workers, and large enough production facilities to accommodate additional people to come in is key to fulfilling larger orders.  Maximum is a good example in this regard. For a solo designer-maker, the knowledge transfer is more difficult, but an apprentice can make sense, especially if part of the work can be serialized. International outsourcing is the other way to go to increase production, with Elvis & Kresse, Freitag and Gompf+Kehrer all adopting this route, either outsourcing to partners under fair trade conditions, or, as in the case of Elvis & Kresse, establishing one's own production facility abroad.

## Everything Else Drives Business/Project Viability

The other dimension of scaling up is business/project viability. The apparent viability of Maximum and Studio Botté confirms the findings of four other upcycling case studies across two publications (which include Elvis & Kresse and Freitag), which show that enterprises built around creating value from waste can be successful (Dominguez & Bhatti, 2022; Kyungeun et al., 2022). While less is known about the success of the other 18 enterprises behind the objects in the design review, the follower numbers, media coverage, and longevity of these companies suggest many are at least surviving well enough.

The case studies paper by Kyungeun et al. also identifies the success factor of competitiveness with non-upcycled products in terms of quality and price, which aligns

with the strategies of Studio Botté, Maximum and many of the objects in the design review. Competitiveness ties into this thesis's identification of *design/creativity value* as integral to the value proposition of upcycling, which also aligns with uniqueness as a key value proposition components of craft objects in general (Doussard et al., 2018). The ability of upcycled goods to trade on their design/creativity value and uniqueness while maintaining production efficiency is a skillful balancing act.

With my design projects made from upcycling lighting components, positive reactions increased with the level of material transformation and craft intervention involved. As the success of bag creators Elvis & Kresse and Freitag suggests, labour-intensive production can be viable with high enough prices, however, this can require an ability to position the objects in the luxury category (Dominguez & Bhatti, 2022) or at least communicate the labour intensiveness involved in the process to help justify pricing (Budgen, 2017). As research on sustainability suggests, the broader environmental and social sustainability practices of these two companies likely helps also.

A key paradox lies in the fact that while upcycling trades on uniqueness among sustainability and design enthusiasts, this same uniqueness can hinder adoption by broader audiences. Yet as upcycling overcomes its barriers to purchase and gains more mainstream acceptance, what is niche becomes less so. One testament to this are the many imitators Freitag has around the world.

In terms of revenue streams, this thesis's two case studies also align with Alchemy Goods in the comparative analysis, and the practices of Kyungeun's furniture case ChopValue in offering custom upcycling commission work to business customers. Architects and interior designers have played key roles in the success of Studio Botté and Maximum by recommending their work to their clients. Distribution through self-run or third-party retailers has been key to Freitag and Dvelas, while effective ecommerce strategies and online and offline community building have been key success factors for others.

As a growth path, scope economies through product diversification can make sense for upcycling enterprises, but their ability to develop new objects also depends on available time. As research on micro enterprises shows, time is one the most precious resources (Achtenhagen et al., 2017) for entrepreneurs, and scaling up through new products is a delicate balancing act in this regard. Maximum's win of a grant for upcycled material research and development helps to give them a window of opportunity in this regard.

### Meso and Macro-Level Factors

Studio Botté's collaboration with an urban reuse center for storage of street lamp globes is a good example of how an upcycling enabler can facilitate production. The

existence of this center and its ability to secure municipal funding for its warehouse align with research findings related to the meso-level enabler of "strengthening system-level waste solutions," and the macro-level enabler of "provide support for waste upcycling resource hubs" (Caldera et al., 2022). Reuse centers can have amazing impact, as evidenced by the Återbruket center in Gothenburg, Sweden, which was found to have directed 72% of its materials to reuse, resulting in the reduction of 1,300 tonnes of $CO_2$ and 5100MW/h of energy use (Ordoñez, 2019).

Adoption factors in Maximum's circular business model canvas include France's circularity-supportive environment, which has certainly contributed to it winning its R&D grant, but also offered the possibility of the firm taking part in large CE events located in the city. France has been recognized as an advanced country in terms of transitioning towards a CE, and has been the first to implement the EU's CE directives into national law (Mazur-Wierzbicka, 2021), while Paris has adopted a bold CE vision and set-up eight working groups including one specifically dedicated to "new economies, performance and reuse" (Fratini et al., 2019). All of this helps create a favourable social-cultural and political environment for companies like Maximum to succeed, with legislation and incentives identified as particularly helpful to circular enterprises (Aloini et al., 2020; Gennari, 2022).

Among other factors, technological developments such as RFIDs, blockchain and Internet of Things are starting to align in support the scaling up of material reuse, especially in the building materials and textile sectors (Copeland & Bilec, 2020; Ghoreishi & Happonen, 2022; Talla & McIlwaine, 2022). A recent report by McKinsey & Co. affirms that with an investment of €6 billion to €7 billion, 18% to 26% of textile waste could be recycled into usable fibres to make other textiles with by 2030, generating 15,000 jobs and profits of €1.5 billion to €2.2 billion for the textile recycling industry, and reducing $CO_2$ emissions by four million tonnes (Hedrich et al., 2022).

Recycling appears exponentially more scalable than other forms of reuse. We as designers, researchers and citizens still need to push for reuse before recycling, legislate to hold companies accountable through Extended Producer Responsibility, incentivizing them so that they design their products to facilitate remanufacturing and other forms of reuse, and design efficient reverse logistics take-back systems to make it all happen.

## A Design Guide to Build Upcyclers' Capacity

The upcycling design process proposed in this thesis aligns with the idea of a "design guide for upcycling" identified as a meso-level enabler of upcycling (Caldera et al., 2022). Indeed, the project of turning this section of the thesis into a guidebook could, if given effective communication support, could give it real impact in terms of building capacity among designer-makers and others considering upcycling. Understanding this

process from the start would of course been highly useful to my own design projects, helping me to better evaluate the scalability at the opportunity assessment stage. Even if I would have continued with the material because of time constraints, a proper evaluation of material experience using Material-Driven Design methods identified could have led to other types of objects.

Hanna's Jörlén proposes that her circular design process for building materials could take the form of an interactive, user-friendly digital tool, which could enable users to integrate their findings over the course of the project (Jörlén, 2020). While not as detailed as an architecture project, an object upcycling project can easily require in-depth research and evaluation over several months (especially given the designer-maker's other on–going activities). An interative tool, which could be as simple as a template to use with existing project management software, would allow projects to be tracked more effectively through the various stages and enable different material options to be compared to one another. As a first step, a nicely designed guidebook in the form of a PDF document would enable easy dissemination in collaboration with existing circular economy organizations. "Support for capacity building" has been recognized as another way to enable upcycling (Caldera et al., 2022) — an enabler which doesn't necessarily require a lot of investment. Given the strategic, detailed nature of this process with its business planning components, a dissemination program for such a guidebook could be targeted towards professional designers and design strategists within design and architecture studios, manufacturers or those working independently.

## Research Limitations

*Design-practice-based projects:* reactions to these during the exhibition were not measured in any way, so statements in this regard are based on my memory of people's general level of enthusiasm.

*Case studies:* Time only allowed for two in-depth case analysis; additional cases would have further substantiated findings.

*Comparative Analysis:* The objects were all based on upcycling through repurposing except for one, which used creative repair. Information gathered was based on the websites, social media channels, and in some cases articles on the companies. All companies were additionally contacted by email for further information on their production process, however, not all companies responded to the emails, and thus some information about processes, challenges and enablers was inferred based on the author's experience and understanding.

*Strategic Process for Upcycling Design:* This process has been designed with furniture and interior design objects in mind, with the idea that it could also embrace other types

of objects. This proposed process has not had a chance to be validated by any upcycling practitioners, and I look forward to any feedback that people may wish to share in this regard.

## Future Topics for Research

The potential suggested from the tiny sample of manufacturers warrants validation through a study surveying manufacturers across a selection of sectors to qualify and quantify their waste streams, confirm their accessibility, and validate their reuse potential. While such a study could potentially be large scale, it could start with reasonably small samples across just a few sectors considered to offer good potential. More broadly, similar studies could be conducted among various levels of government administration, and different types of institutions. Making the results of such research available to the public could help trigger the creation of upcycling projects by offering a list of material opportunities considered to have a least a certain level of design potential, and ready to be further evaluated.

The fashion sector accounts for a significant proportion of upcycling-related research. Given the importance of furniture waste and its potential for reuse, and the scope of furniture and design objects being created through upcycling, this sector warrants further research in the form of case studies, and research on consumer perceptions.

As craft plays an important role in upcycling, research on how craft production processes impact upcycling design and production would be beneficial. More broadly, an analysis of material transportation, storage, preparation and production processes in upcycling could help identify further opportunities for optimization.

Finally, further micro-level research on business viability and growth among upcycling enterprises could help quantify success factors in terms of real-world experiences and contingencies, and identify additional feasible paths towards scaling up.

## Personal Practice and Thoughts

All of this work expands my own design practice on multiple levels, pushing my conceptual understanding of upcycling and the very tangible realities of the work processes involved with the affordances and constraints of working with existing material. I have gained a particular appreciation for the knowledge of craft processes — what can and can’t be done with materials with a given set of tools. Analyzing upcycling design and production approaches and their respective impact on scalability across the comparative analysis and case studies gives me a particularly sharp lens through which to analyze my own design work, and with the upcycling design process, I have the framework to guide me more effectively through my next projects.

While we inch closer — politically, socioculturally, economically and technologically — towards a possible world of circular resilience, upcycling through repurposing offers a fascinating world in itself, subverting the classic human-object relationship and introducing additional strands into the narrative to spark our imaginations and give us stories worth sharing. From a dusty discarded window blind made into a beautiful light, to a giant wind turbine blade made into a bridge, upcycling can be incredibly inspiring. Giving designers-makers the insights and tools to organize their process and scale up can potentially enable them to earn a decent living from their practice, help them to inspire others and create positive impacts on a social and environmental level.

There are no silver bullets in upcycling. Only a few choices that can lead to somewhat improved possibilities of scaling up if stars are aligned and the designer-maker-entrepreneurs are willing to go there. The possibilities for upcycling so-called waste are vast. All that's needed is a spark of an idea, vetting to ensure it has legs, a bit of organization, and the drive to bring it to life.

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# Appendices

# Appendix A
# A Brief History of Upcycling

Upcycling has a rich history which continues to evolve, as a DIY practice, a professional practice, and as a form of consumption. Given that the work of current day upcycling designers is necessarily situated within this history, a few salient highlights are presented below.

## Evidence of Early Practices

Science historian Maikel Kuijpers suggests that the repurposing of objects probably started at the same time as tools, with small flint tools during the Palaeolithic period made from old hand axes, and large stones, used as grindstones during the Neolithic era, were often later repurposed as anvils, doorsteps, or even tombstones (Kuijpers, 2019).

In *A Short History of Scavenging*, the authors point out what is believed to be the first tangible evidence of reuse or at least recycling intentions: pieces of Roman bronze statues dating from fourth century BC to third century AD, found in 1992 by Italian archeologists in a sunken ship in the Adriatic sea (Downs & Medina, 2000).

A historically important application area of upcycling has been the built environment, which accounts for 40% of the world's solid waste (Ali, 2017; Ness and Xing, 2017; as cited in Jörlén, 2020). In the compendium *Upcycling: Reuse and Repurposing as a Design Principle in Architecture*, Daniel Stockhammer notes the field of architecture is very gradually rekindling once commonplace practices of reusing materials from previous building and infrastructure construction (Stockhammer & Koralek, 2020). Indeed, the reuse of antiquity's *spolia*, Roman or otherwise, in Middle Ages architecture, has been the object of much research (Brilliant & Kinney, 2016).

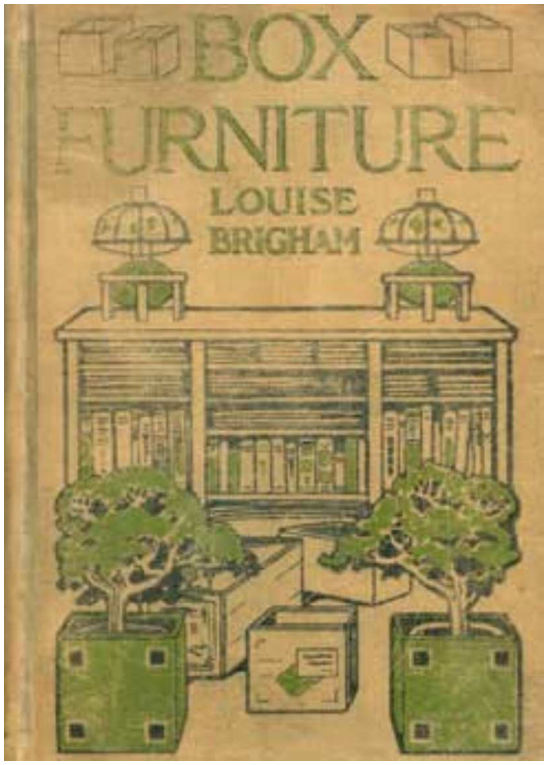
Anthropologist Macolm Blincow finds a wide range of evidence of scavenging and recycling activities in Britain and France from the eighteenth through the twentieth centuries, notably carried out by "street-finders" and "collectors" (Mayhew, 1968, as cited in Blincow, 1986) and points out out that materials gathered could be reused directly or transformed (Blincow, 1986), suggesting upcycling was taking place at the time.

## Early Upcycling Processes and Wartime Salvage

This preoccupation is hardly a new one. Early 20th century designer and teacher Louise Brigham was an early modern-era pioneer of reuse. Following two summers spent in

the Norwegian coal-mining camp on the island of Spitsbergen, Brigham set out to help alleviate the harsh conditions of the camp by transforming wooden supply boxes into furniture. In 1909, she published a book, entitled *Box Furniture* (Fig. A1), which offered skilled homeowners a step-by-step DIY manual for building furniture room by room using such wooden boxes as material ("Louise Brigham," 2022). The social aspirations of the book seem clear in this project "at the nexus of the Arts and Crafts Movement, Progressivism, and other reform efforts of the day" (Gilbert-Merrill, 2022)

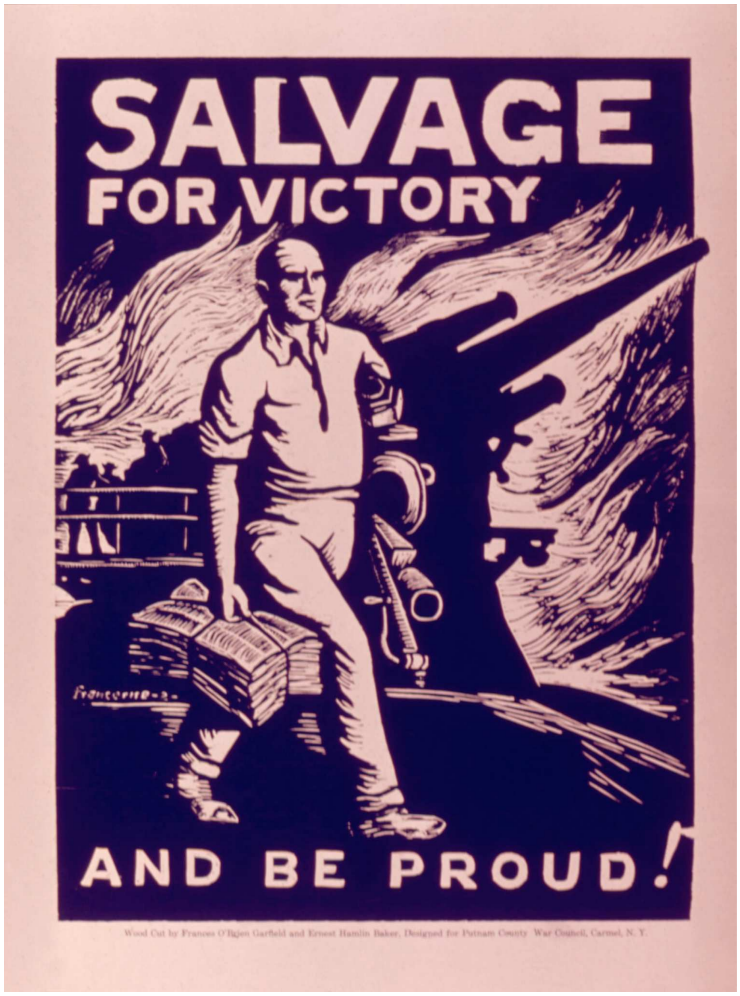
Figure A1: *Box Furniture: How to Make a Hundred Useful Articles for the Home*




*Note.* Digital scan of a book cover illustration. From *Box Furniture: How to Make a Hundred Useful Articles for the Home*, by Louise Brigham, 1909, New York: The Century Co. Public Domain image. Retrieved from https://en.wikipedia.org/wiki/Louise_Brigham.

The military manufacturing needs of World War II led to intense salvage campaigns (Fig A2) in both Germany and allied countries to direct post-consumer iron, steel and aluminum waste such as tin cans, but also useful items such as pots, pans and fences to be melted down and turned into aircraft parts, bombs and the like. Analysis has found the usefulness of these recycling efforts as relative and often as much political in the sense of making citizens feel part of the war effort (Denton & Weber, 2022).

Figure A2: *World War II salvage campaign poster encouraging reuse*




*Note.* Digital scan of a poster. Salvage for Victory campaign poster, 1942, by Ernest Hamlin Baker and Frances O'Brien Garfield, designers, for the Putnam County War Council, Carmel, New York. Public Domain image. Retrieved from https://en.wikipedia.org/wiki/Salvage_for_Victory.

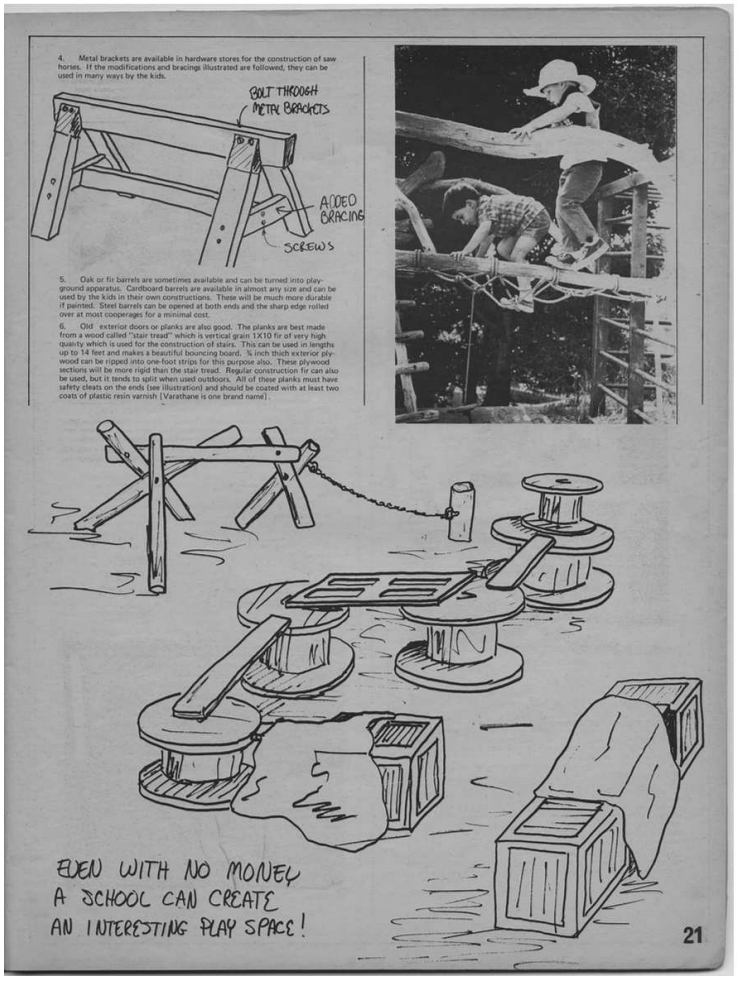
In parallel, citizens were encouraged to repurpose household items to meet their needs, as evidenced by the British government's campaign "Make-Do and Mend" (Jencks and Silver, 1973, as cited in Lee, 2019).

## Counter-Culture Movement and Sustainable Design

The upshot of these wartime salvage campaigns is that later counter-culture movements were able to revitalize ideas of recycling and reuse as part of the growing ecological awareness coming out of the 1960s and early 70s. The ideas fueling their movements found validation in *The Limits to Growth*, an influential report on the dire consequences of exponential growth in populations and resource consumption and the more sustainable possibility of working towards an equilibrium that embraces ecological as well as economic interests (Meadows et al., 1972).

Inspired by the counterculture magazine and catalog of useful tools for eco-minded self-sufficiency projects *The Whole Earth Catalog*, the publication *Big Rock Candy Mountain* offered inspiration and plans to fuel sustainable design and building of infrastructure for free schools, i.e.: alternative community schools (Castillo, 2018). The project ideas for a DIY play space we see in a page taken from this publication are evidence of upcycling processes being disseminated at the time (Fig. A3).

Figure A3: *Upcycling Design Ideas for Free School Play Areas*

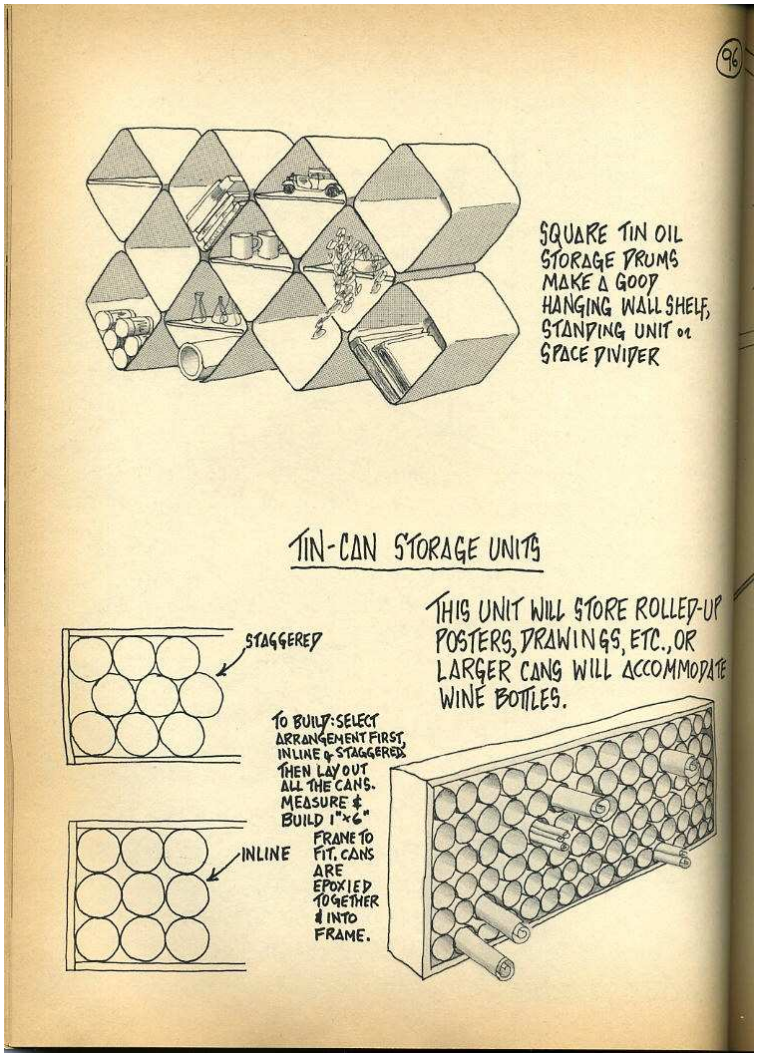



*Note.* Upcycling-driven design ideas for free school play areas [Scan of a page from "Educational Environments—Play Sculpture," in *Big Rock Candy Mountain: Resources for Our Education,* S. Yanes (Ed.), (Winter 1970)] as republished in Salvage Salvation: Counterculture Trash as a Cultural Resource, by G. Castillo, (2018) in F. Karim (Ed.), *The Routledge Companion to Architecture and Social Engagement* (p. 310). Routledge. https://doi.org/10.4324/9781315712697

Designer and educator Victor Papanek came to fame during this time with his 1971 book *Design for the Real World,* a highly prescient critique of modernism and the excesses of design of all forms. He followed that up, collaborating with fellow designer James Hennessey, with *Nomadic Furniture* (1973) and *Nomadic Furniture 2 (1974),* two guidebooks cum catalogues explaining "How to build and where to buy furniture that

folds, inflates, knocks down, stacks, or is disposable and can be recycled." (Hennessey & Papanek, 1973, cover copy)). The books' plans make ample use of cardboard, as disposed metal objects such as tin cans and square oil drums (Figure A4).

Figure A4: *Tin-Can Storage Units*




*Note.* Tin-Can Storage Units [Scan of a page] from *Nomadic Furniture,* Hennessey and Papanek, (1973). Atglen, Penn: Schiffer Publishing. ISBN 978-0-7643-3024-7. https://knittingiris.typepad.com/knitting_iris/2008/05/another-favorit.html

## Makers and Consumers Embrace Upcycling

The website UpcycleDZINE lists over 400 designer-makers and their upcycling projects. A growing number of craftspeople and designer-makers have been observed using maker spaces and online platforms such as Etsy to adopt upcycling as a creative and production approach (Sung et al., 2014). Indeed, a search for "upcycled" on Etsy results in over 482,000 items offered for sale, ranging from $3 fridge magnets made from bottle caps to a $71,000 table made from a jet engine cowling.

As a search term, “upcycling” has been growing steadily since 2010 according to Google Trends, possibly as a response to the financial crisis of 2008-2009 and its aftermath, with blog posts and social media fueling the buzz with upcycling-related projects. As of writing, Amazon lists 638 book titles related to “upcycling”, and a search for relevant keywords on Instagram results in 6.2M posts for #upcycle, 1M posts for #upcycledfurniture and 865K posts for #upcycledclothing, among dozens of other hashtags derived from the words #upcycling and #upcycled.

## Big Brands Get On Board

Larger enterprises have been looking to improve their sustainability track records and a number of them have embraced upcycling in various ways. To take two examples, Adidas partners with Parley for the Oceans to upcycle end-of-life fishing nets into shoes (Piroddi, 2016), and the fast-fashion-driven H&M Group recovers and upcycles denim and clothing from its COS label into limited series collections (H&M Group, 2020). With the Covid19 pandemic resulting in double the volume fashion industry’s end-of-season leftover merchandise known as “deadstock”, even luxury brands such as Miu Miu, Maison Margiela, Gucci and Balenciaga (Fig. A5) have turned to upcycling in various creative ways, designing clothing and accessories from previous season items as well as remnants from the production process (Bala, 2021; Chan, 2020).

Figure A5: *Coat and Bag Made from Upcycled Denim Clothing by Balenciaga*

*Note:* Balenciaga Pre-Fall 2021 Collection [Photograph] (2021) by Balenciaga. Retrieved from: https://www.vogue.com/fashion-shows/pre-fall-2021/balenciaga/slideshow/collection#9

## Upcycling in Developing Countries

In low to middle income economies, informal sector-led recycling (a term which logically includes upcycling activities in this context) is an intrinsic part of environmental and economic systems, with waste pickers involving by one estimate up to 2% of the population of some countries (Medina, 2000). This results in a range of intermediate and end-use products created using a healthy dose of creativity and flexibility to meet market needs (Wilson et al, 2006; Ojeda-Benitez et al., 2002; as cited by Ezeah et al., 2013).

Social semiotics researchers Archer and Björkvall (2017) have found that while developing world upcycling is often driven by economic need, and results in artefacts that offer critical commentary on issues such as globalization (Fig. A6), its products can often end up in the Western consumer marketplace, muddying their perceived ethical consumption qualities: “Upcycling can refract racial, gendered, classed and countercultural identities and can mobilise social and cultural difference for profit.” (Archer & Björkvall, 2017 p. 29, para. 2).

Figure A6: *Console Table Upcycled From Oil Barrels*

*Note.* Red Console [Photograph], Bertrand Bagoro, designer, https://www.ilab-design.africa/en/concept-store/hamed-ouattara-console/

## Upcycling's Evolving Role in Consumption

Among their analysis of three cases illustrating their integrative theoretical framework of consumption ideology, consumer and marketing researchers have examined upcycling under the lenses of social theory and ideology-related previous consumer research. The authors view upcycling in developed countries as "a manifestation of consumption ideology resulting from conflicts in the consumer's lived experience between the consumerist objective of constantly buying new products and consumers' desire to reduce consumption" (Schmitt et al., 2021, p. 85). From this form of "active resistance", they see an evolving set of behaviours which work as a dialectic processes with the marketplace: First, consumers create their own upcycled objects from materials in their possession. Secondly, some consumers start selling their upcycle objects. Thirdly, companies co-opt the idea and start producing their own upcycled products and marketing them under their brands. The stage we are arriving at now is where consumers either accept the market's proposition as a coveted object of desire, status symbol and or new mode of consumption, or reject it as insidious and seek out alternatives (Schmitt et al., 2021).

Where do upcyclers situate themselves within upcycling's evolving relationship with consumption? Is there anything that they can do to influence their relationship with consumers in this regard? Will the circular economy turn various forms of reuse and even repurposing into a banal practice? While there are no easy answers, each upcycling designer needs to think about issues and decide on their way forward.

# Appendix B
# Material Exploration and Concept Ideation Process

The lighting components sourced from Eureka lighting offered interesting geometric forms (Fig B1).

**Figure B1:** ***Eureka Lighting Components Unpacked***

The components were mostly made of aluminum, some from steel. They each had their own finishes: clear coats, powder coating or anodization. Some had pre-cut holes or built in bolts in preparation for assembly. The components shared characteristics of

simple geometries, clean finishes and basic colours plus shiny aluminum. There was also a good amount of acoustic felt, with sound absorbing properties.
Technical assessment of materials and their affordances would come later, once design projects were underway. This is not necessarily the most efficient process, and probably not the approach that an industrial designer or engineer would take, but more of an instinctive design approach: create first, solve problems after.

## Collection Concept, Prototype Assemblies and Sketching

The idea was simple: a collection of functional furniture and accessory pieces for the home or small workplace. These lighting components could work as legs, and others that could provide flat surfaces. Their commonalities could help form a coherent aesthetic, complemented by additional materials required to complete certain pieces.

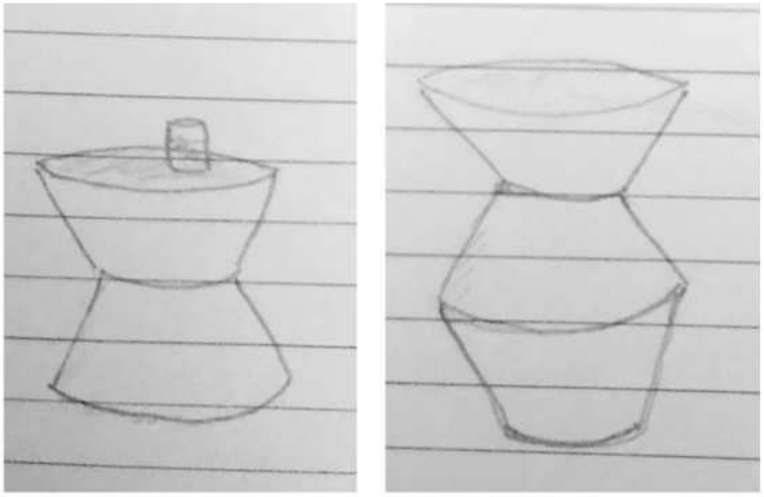
The finished nature of the material enabled me to quickly try out certain ideas simply by juxtaposing pieces together (Fig. B2). The result was close to something “ready made”, and iterating turned into a fun game (Fig. B3)

Figure B1: *Prototype Assemblies for an End Table*

Figure B3: *Prototype Assemblies for Living Room Tables*

This process was instinctive with pieces that could hold together by themselves. Sketching allowed ideas to flow freely, suggesting the modularity of certain concepts (Fig. B4), and that certain pieces could be used more than once across the range of objects (Fig. B5).

Figure B4: *Certain Concepts Suggested Modular Possibilities*



**Material Exploration and Concept Ideation Process**

Figure B5: *Furniture and Object Concept Sketches*

# Appendix C
# Design Development and Prototype Making

## Material and Technical Affordances

The “side table” project (which later evolved to something more than just a side table) offers a good illustration of the ins and outs of designing and building a prototype with this kind of material in an upcycling perspective. The plan was to drill holes to bolt two anodized aluminum lamp shades together to form an hourglass or basket shaped table, depending on orientation, and then cut the flat round piece to fit. I quickly ran into two issues related to the existing form of the material, and what certain tools would allow:

- The lip of the lampshades was curved inwards, making it difficult to drill, and requiring an additional operation of sawing and flattening tabs which could then be drilled as attachment points.
- The plasma cutter needs a clean metal surface to cut through, so the existing powder coat needed to be removed with a grinder

After working through the first issue with some difficulty, I discovered a much simpler way to attach the two lampshades together. The curved lips enabled a secure edge for fastening using bull clips of the right size — a beautifully simple solution reminiscent of shelving projects I’ve seen in the past aiming to circumnavigate the use of brackets or joinery.

## Craft Interventions

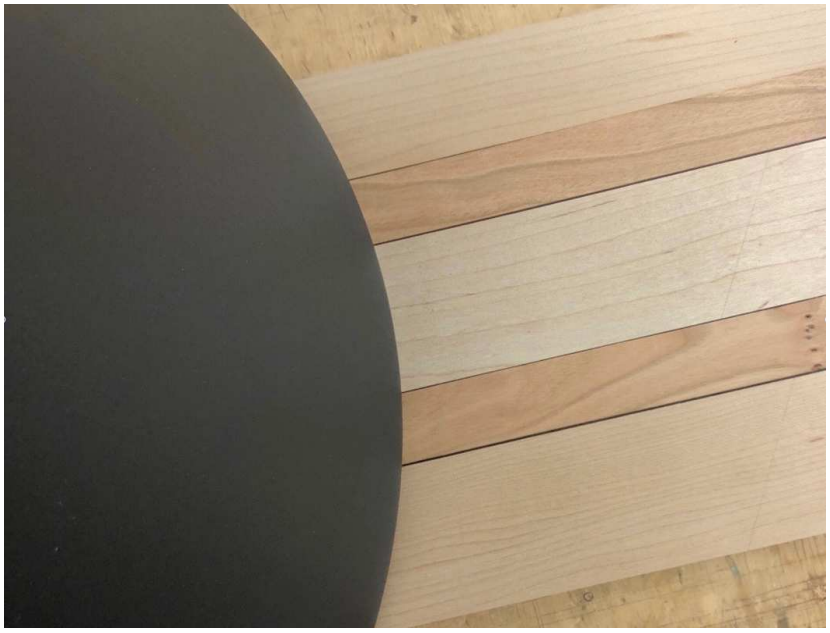
I tackled the second issue with a grinder, which took some time. During this work, I started to notice patterns appearing in the flat steel piece. I decided these patterns could potentially fit into the aesthetic of the table, so I did another quick session to make the patterns circular and give a more intentional feel to the result. From the initial idea of preserving the durable powder coating as a table top, the constraint of the plasma cutter had led to an additional process, but one where craftsmanship can play into the result (Fig. C1).

Figure C1: *Patterns Formed by Grinder Work Used in the End Table*

I was not however completely satisfied with the prototype. The end table, made completely from steel and anodized aluminum, looked sharp, but felt cold, somewhat harsh. This was the nature of the material. I thought of finishing possibilities, such as a brightly painted top, but felt like I needed to explore beyond the lighting components, so I decided to see if wood could be used for the top.

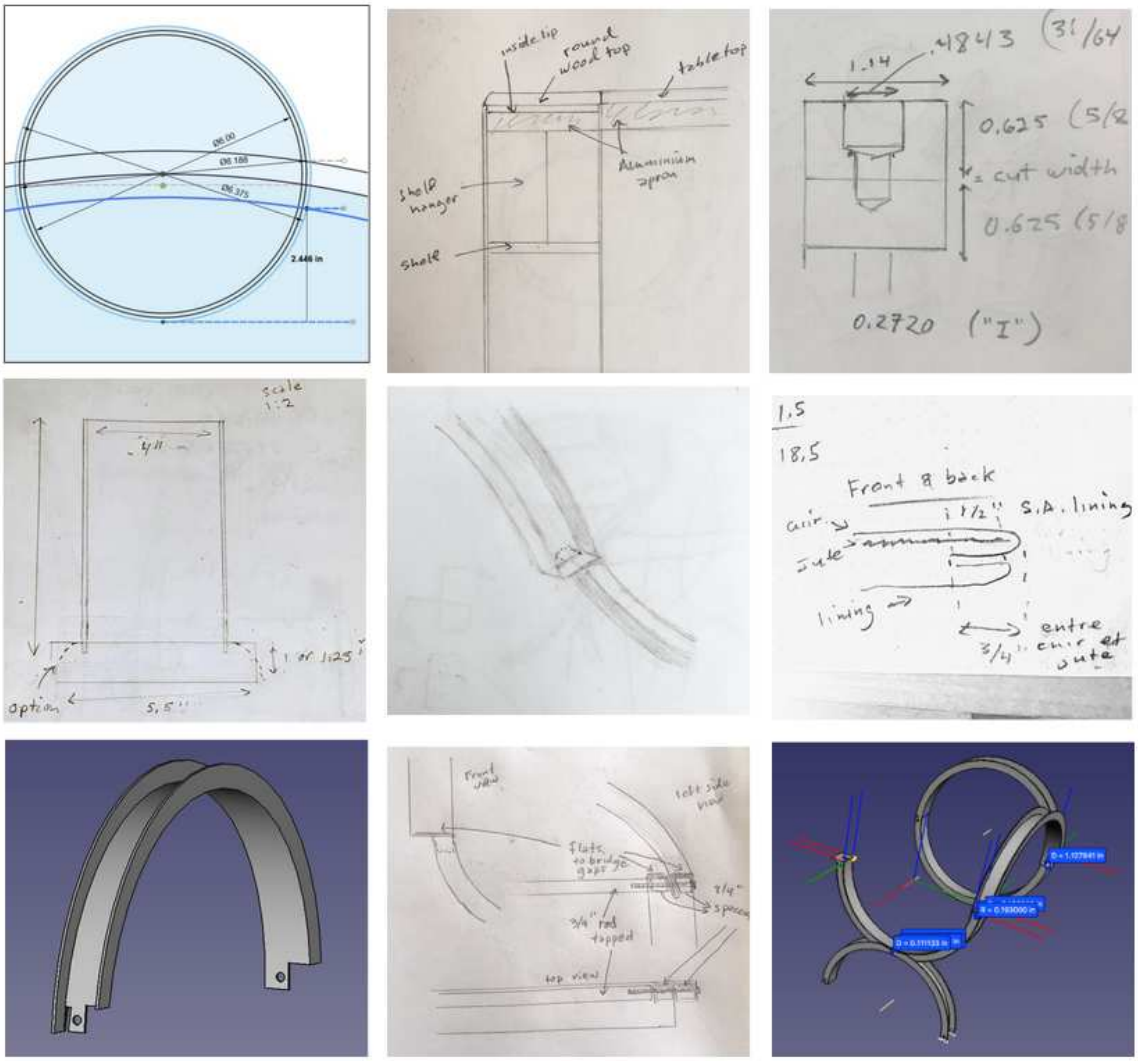
I explored the university wood shop's section of scrap pieces, and started making juxtapositions. This led to a moodboard, bringing the anodized aluminum next to a selection of wood pieces of alternating species and colours (Fig. C2) The resulting effect was warm and pleasing.

Figure C2: *Mood Board for a Wood Top for the End Table*



Wood shop processes feel more craft oriented, even though engineering is just as required. Tom, the lead technician at Concordia's CTC wood shop, loves to solve problems sitting at a table sketching on scrap of paper, using the engineering skills he has picked up over the years. Accustomed to more precision, metal shop technicians were more demanding in terms of technical drawings that I needed to prepare (Fig. C3)

Figure C3: *Technical and 3D Model Drawings for Projects*



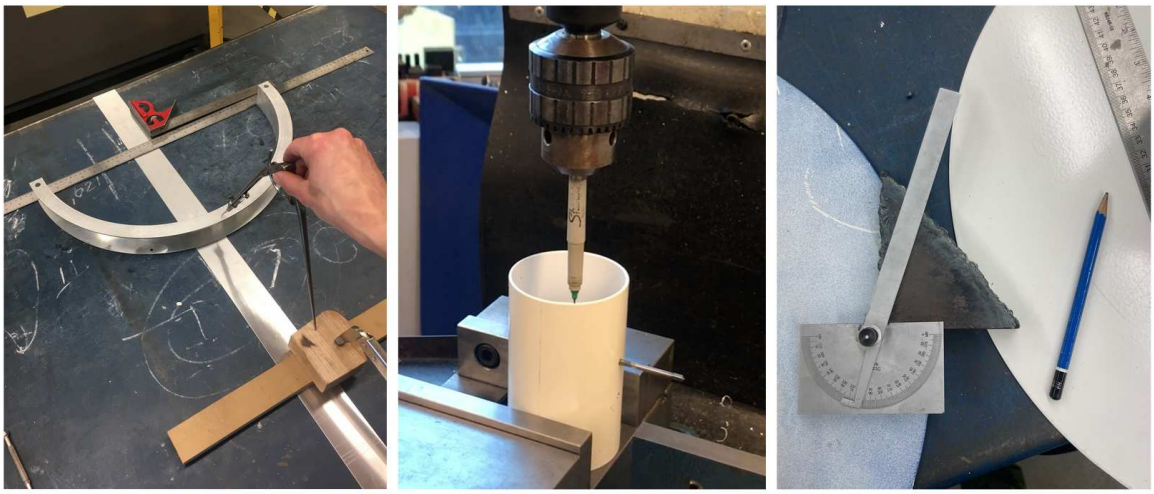

## Making Processes

Prior to each work session, the project and processes would be discussed with shop technicians, mostly on Zoom at the time, but ideally with the material in their hands (Fig. C4). With their depth of craft knowledge, would invariably have insights into the process and suggest changes or give tips to help arrive at the desired result.

Figure C4: *A Project Consultation with Concordia Metal Shop Technicians Via Zoom*


Working with existing objects means adapting to their existing dimensions, which sometimes calls upon the science (and art) of industrial metrology, which refers to measuring and marking but also the tools and techniques to carry it out (Fig. C5).

Figure C5: *Measuring and Marking Existing Objects*



Metal shop work typically involves hard work and focus (Fig C6.) and carrying out this work has given me a respect for the idea of industry, and the skills of factory worker carrying out repetitive tasks with discipline to produce parts to exacting standards. Wood, on the other hand, with its warmth, its more direct connection to nature through the colours and grain patterns, and its more easily shapeable qualities, offers a more flowing connection with the material across wood shop operations (Fig. C7).

Figure C6: *Metal Shop Processes*

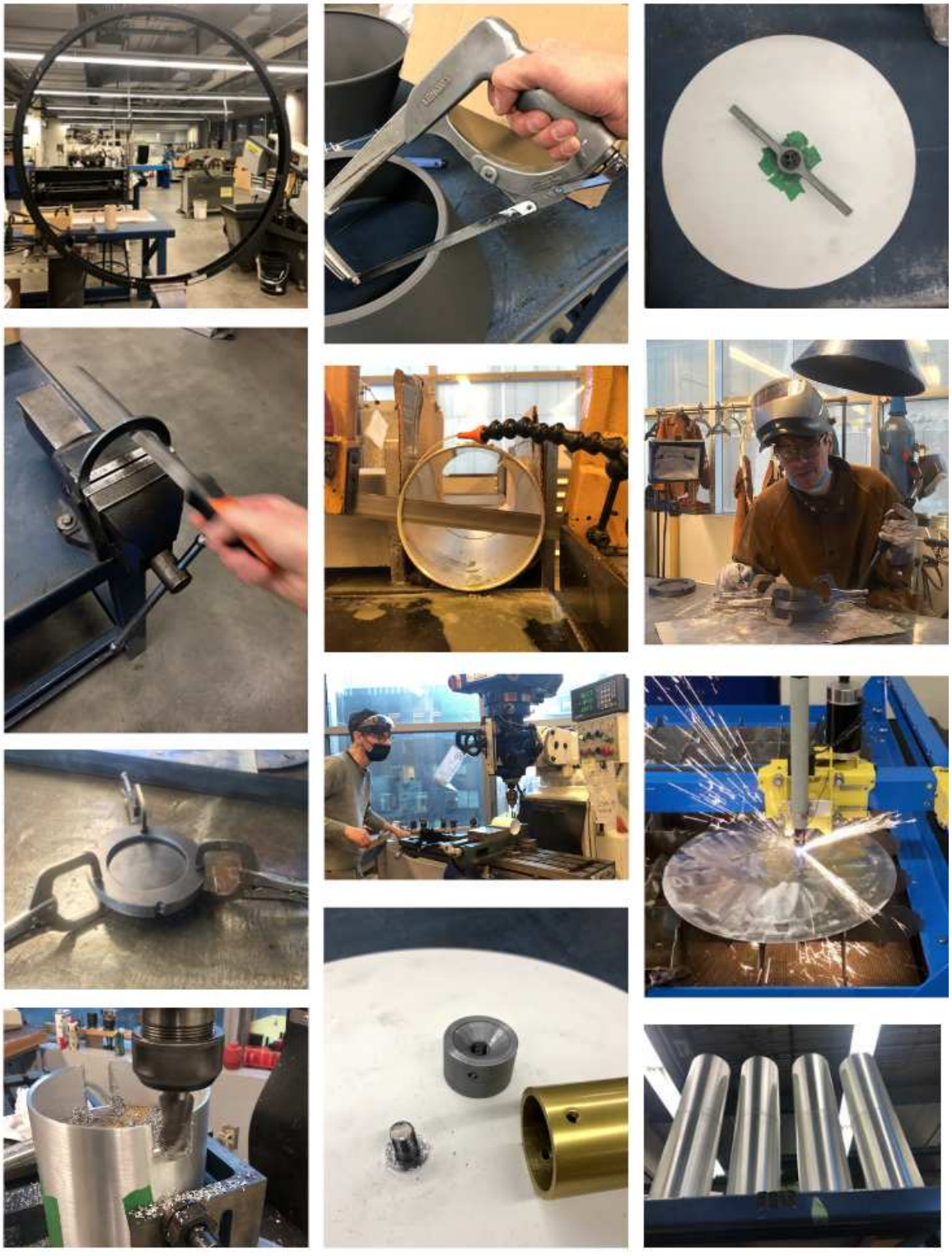
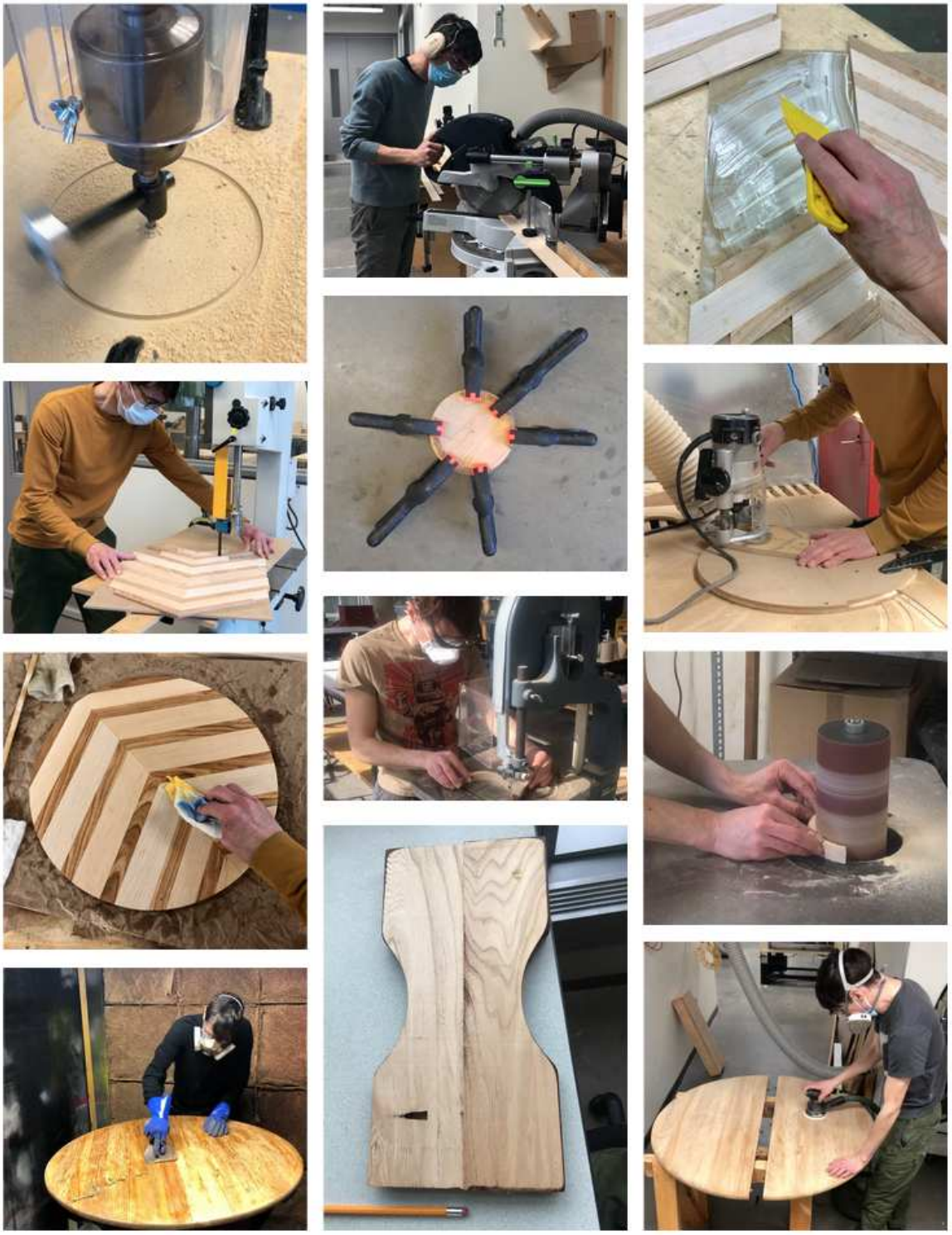


Figure C7: *Wood Shop Processes*



I found it easy to lose all sense of time during a good sanding session, experiencing a flow and transfer of energy from my hand, through the orbital sander and then the sandpaper, to the table in something akin to Malafouris's potter working with clay. While my main concern is removing remnants of the table's varnish and maintaining an

even flatness of surface, I experience none-the-less this connection of mind, body and material, whereby the material also has agency in its response to my actions (Malafouris, 2019). The natural colour and grain patterns of the wood reveal themselves, and tell me when to stop sanding.

At other times, materials would simply not yield to my will, due to my lack of skills or knowledge of the limits of the process I was pursuing in regards to these existing materials. The bit of hand-held drill would not stay straight within the pre-punched hole on the smooth clear-coated roundness of an aluminum cylinder; wood pieces glued together would not stay flat; leather would bunch up under the needle of the sewing machine, preventing me from producing a flat seam. In all of these cases, I was grateful to be able to turn to the technicians for guidance in dealing with the material's affordances.

Sewing and upholstery were a particularly new world for me in this regard, and working with an old leather coat brought me into the world it was made in (Fig. C8). As a complete novice, every step in the process raises questions, driving home the challenges of scalability in an unequivocal way.

Figure C8: *Sewing Shop Processes*


Finishing is a whole world in itself, offering tantalizing opportunities to elevate the work to the next level, or fail miserably, requiring finishes to be removed and done over. I spent many hours in Concordia's spray room (Fig. C9), spray painting, stripping, staining and gluing — anything that involved toxic fumes. Achieving a nice finish is a matter of tools, technique and practice, and when the stars are aligned, you can get into the zone of it.

Figure C9: *Spray Room Processes*

## Design Development and Prototype Making: Takeaways

These deadstock and non-compliant units of very finished lighting components have come with structural qualities, interesting forms and finishes, and these have influenced the design concepts, leading me instinctively to preserve much of their forms. The clean, aluminium, grey, black and white finishes impose a certain modern industrial aesthetic onto the concepts, leading me to seek alternative paths in terms of material and craft processes, to bring back some warmth and humanity to the pieces.

Making processes can be enthralling: discovering how tools work, how they can be used effectively, and seeing the piece coming into being as a result of the work. I found myself at times overly eager to get back in the shop, take advantage of time slots available before my design concept or its issues were fully worked out on paper. As a result, some work sessions resulted in work that was unusable.

In terms of engineering, I was looking for relatively precise tolerances in terms of fit, while the tools and processes of the metal shop were not all designed to result in such precision. This is also a question of means vs. goals, and my goals had to be adjusted to available tools, as well as to my still emerging craftsmanship skills.

“Every tool leaves a mark,” says metal shop veteran Brian Cooper. Such marks are an integral part of the craft process, and can be desirable to keep as part of the final piece.

Working with wood draws you completely into the craft of the work and a connection with the material, where hours can fly by without notice, and when the outcome is good, results in a deep sense of calm and satisfaction. Working with reclaimed materials feels like it is inherently about “slow design”... Ways to speed it up in the interest of scalability would require further research, but a CNC router suggests possibilities in this regard.

# Appendix D
# Design Projects 5, 6, 7

## Design Project 5: Half Moon Shelf

This project was satisfyingly simple to produce. I started with a round flat 19-inch diameter inner lighting component (Fig. D1). Highly useful, these flats were used in various ways in four designs of the collection.

**Figure D1:** ***Round Flat Lighting Component as a Basis for a Shelf***

For the shelves, the task was to remove the built in bolt with a grinder, drill some mounting holes, and then bend the thing at a 90 degree angle to turn it into a half moon shelf with the help of the CNC brake press — easy peasy. Except... the gauge, 15, was an odd one, and the powder coat may have been a factor. The result was not exactly 90 degrees, but close enough.

To elevate the design, I found a deep blue violet spray paint in a matte finish, which worked well with the colour of some of the felt pieces I decided to top the shelves with acoustic felt from Eureka's Mute series (Fig. D2) giving them a soft, tactile surface — not the most practical for washing, but an interesting addition.

Figure D2: *Mute Suspension Light by Eureka Lighting*

*Note.* Mute Ceiling Suspended [Photograph] (n.d) by Eureka Lighting https://www.eurekalighting.com/products/mute-2/

Not ideally positioned within the exhibition space, the resulting shelves (Fig. D3) didn't attract the most attention. Attendees also assumed they were made from new materials. On the other hand, this was the piece people expressed most interest in purchasing, perhaps as a practical storage or display accessory, easy to install and integrate in people's homes.

Figure D3: *Half Moon Shelves in the MDES22 Exhibition*

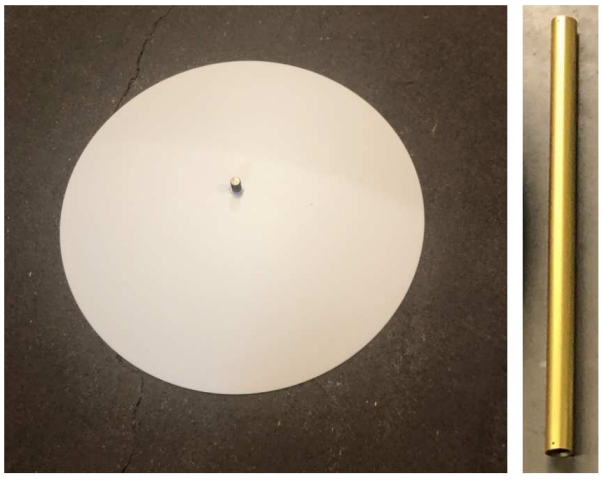
# Design Project 6: Catch-All Pedestal

Many furniture pieces have all but disappeared from our modern-day lives. Such is the case of the pedestal stand or table, known in its ornate embodiment as a *guéridon*, a small table supported by a single or often three legs, often serving to hold a candelabra or a vase. During much of the 20th century, such a table might've had a telephone. Another item from a bygone era is the catchall, also spelled catch-all, which can be defined as "something that holds or includes odds and ends or a wide variety of things" ("Catchall," 2023). This "something" could be a tray, a bowl, a large shell, or anything that can hold things.

With the Catch-All Pedestal, I'm proposing a freestanding version, handy in entrance areas (where there is often no shelf or console) to be able to catch one's wallet, keys and phone as you come into your home.

The piece came together with three Eureka lighting components (Fig. E1), namely two gently arched dome forms with built in bolts, and a green-gold anodized aluminum rod that was just the right height. Fitting it all together involved creating perfectly-sized threaded brackets to insert into the rod and be held in place by set screws, brackets which required cutting solid steel, lathe machining to size, drilling and tapping. Besides these pieces, the project could be done without modifying the Eureka components.

Figure E1: *Lighting Components Perfect to Make a Pedestal Stand Out Of*



The resulting design (Fig. E2) only needed a well-sized piece of acoustic felt so metal objects such as keys wouldn't damage the existing powder coat. I'm pleased with the trim functional elegance of the piece. The white feels a tad generic, but works easily within a variety of decors, and the gold rod elevates the effect.

Figure E2: *Catch-All Pedestal*

Initially displayed without accessories, some people mistook the piece for a freestanding ashtray. With the addition of an old mobile phone and eyewear, people grasped the concept immediately, and some admired the practicality of the idea as a way to keep track of things, while others liked the idea of leaving their phone at the door. Not everyone could imagine making space in their apartments for such a piece, but the concept seems to have some legs.

It may also garner more interest as an elegant plant pedestal, as there is a common need to raise plants up to the sunlight, and often a lack of table or shelf space to do so.

# Design Project 7: 70˚Table

Using the same aluminum cylinders as the dining table and the same flat rounds of the shelves, I set out to make an improbable side table, one that would stand up at an angle. This involved cutting the cylinders at an angle, designing brackets to attach the flat round tops to the legs, and weighing down the legs so they wouldn't tip over. Somehow, my sense of physics was off, as no amount of rocks or heavy steel pieces inserted into the resulting angled leg of the table would prevent it from falling over with a glass on it. The only trick that worked was to place the flat top such that its weight was as far forward over the leg as it could go, and the glass at just the right spot. Only with these acrobatics would the table hold up for the exhibition photo (Fig. F1).

**Figure F1:** ***70˚ Table, Perfectly Adjusted to Hold Up For the Photos***

While I liked the felt top idea, for a side table which often needs to accommodate snacks and drinks, a steel top seems like a better idea. My mother's reaction was that the top was too thin compared to the leg. While the thin-thick contrast was the general idea I was going for with the steel top version, I tend to agree with her.

Needless to say, this table concept is indeed improbable, and needs more work, starting with the same flat round piece being attached to the bottom of the leg in the opposite position so as to stabilize the table and form a Z-shape. This project is in process, with a few iterations of brackets to properly connect the flats now getting close to a functional result. In a Z-form, the table won't be as improbable, but it is still a stimulating use of these shiny aluminum tubes, vaguely reminiscent of a rocket hurtling through space.