AI STYLIST:

WHAT DO I WEAR? MOBILE APPLICATION

by Savaya Ann Shinkaruk

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Savaya Shinkaruk
OCAD University
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Abstract

This thesis is an exploration of the process of getting dressed, and how it is incredibly complex. This paper identifies the multiple variables that go into the decisions and motives people have when styling a complete outfit. These variables will be explored through my expertise of being a personal stylist and shopper, and with expert consultations in different technology fields. The purpose of the *What Do I Wear?* mobile application is to assist people getting dressed by recommending an outfit that suits the users body shape, activity, represents their personal style, and is suitable for the weather. The final product is a mobile application that functions as a personal stylist, utilizing an artificial intelligence agent trained on using identified variables when styling an outfit.

Key words: apparel classifier system, recommendation system, machine learning, mobile application, UX / UI design, business plan

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Clothing is our second skin. Some of us enjoy the experimentation of styling looks together, others have a strict uniform and don't experiment outside their comfort zone, while some will hire professionals to style and pull appropriate outfits. "It's also stressful to have to comb through piles of clothes each morning just to find one acceptable outfit. And of course, if what you wear is important to you, not being able to find anything you truly love will affect your confidence levels eventually, and that's stressful too" (Rees, 2016, p.13). Whatever the case might be, we all aim to purchase clothing that suits our body shape and lifestyle, and style outfits together that represent our personal style.

Working as a professional personal stylist and shopper for the past eight years, I was hired to shop, dress, and build a coherent wardrobe that suited the client. While working in this career I have learnt about the different variables, decisions, and complex ordering of these variables it takes to build a suitable and coherent wardrobe for someone. When you have a wardrobe that works for you, you start to learn more about what you feel comfortable in, which results in spending less time searching for clothing to wear.

Every idea starts with a problem, this problem being getting dressed is complex. The motivation behind why I built this mobile application comes from wanting to make my skills of being a personal stylist available to the mass market, with no expense. I believed I could design a database (see "Appendix B") that incorporates my decision process and critical thinking I do when styling outfits. I named the mobile application, *What Do I Wear?* because it is the go-to question some people will ask or think when getting dressed, this is the question this mobile

application answers by recommending you an outfit. My thesis research is focused on highlighting the important variables that affect the decisions we make when it comes to getting dressed. My thesis project is the *What Do I Wear?* mobile application that incorporates these variables and acts as a daily personal stylist.

(1.1) Personal Experience

I've been working as a sales associate for large retail corporations and independent boutiques, in fashion communications, and as a personal stylist and shopper with styling agencies and through my own business. Currently, I am working as a wholesale associate for *Citizens of Humanity*, a denim fashion brand. The one common thread between all my jobs in this industry is that I want to assist people in building a wardrobe with clothing they loved and felt good in. To take my career one step further I focused my thesis to learn how to build a system where my skills would become available to anyone who is interested or wants assistance in putting together outfits by using their mobile phone.

The ability to look at a blank silhouette and match a pair of bottoms with a top, that suits someone's personal preferences in an outfit is something I have practiced, researched, and done a lot of trial and error on. And, was successful more than I was not, because I found a method of matching clothing and colours together. The reward of someone feeling comfortable with the clothing in their wardrobe, and having the confidence to style outfits because they understand their personal style, body shape, and lifestyle is my goal every time I recommend an outfit or dress myself.

The decision-making process and critical thinking process I use when styling an outfit together for people, is how I have always thought, even when dressing myself. Utilizing my work experiences, I take my personal method of dressing myself by looking at what fits and cuts work well with my body shape, and identify my personal style with the activity I am dressing for to style an outfit I feel good in. In *Figure 1* you can see my method of decisions when getting dressed for myself and when recommending outfits to others. This chart gives insight to the reasons and factors used for picking clothing items and types for the user to style an outfit. These are the same variables used in my database.

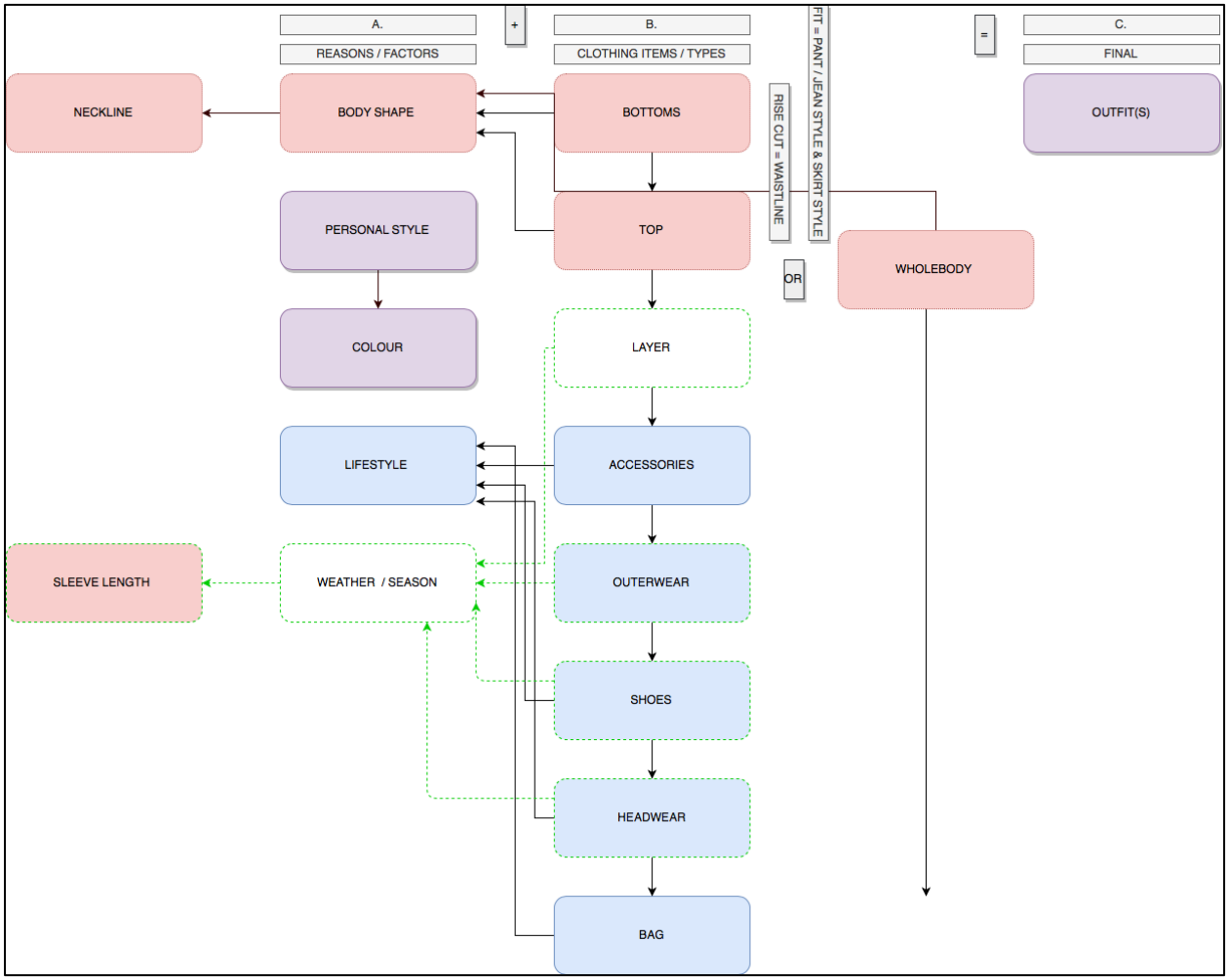

Figure 1: Decision process when styling an outfit

(1.2) Project Overview

Four billion pounds worth of clothing that is returned from online purchases, is going to the landfills on a yearly basis, the fashion industry needs to improve on how we design, talk and teach people about the fit of clothing[1]. When I started working in this industry I noticed the complex relationships people have with clothing. By recommending clothing that matches well together based on the fit, cut, styles and the users' personal preferences, my goal is to have them learn about the different fits, cuts, styles and colours that work for them, so they do not need to spend money on experimenting with these variables. Which impacts how much we purchase when we shop and ultimately how much we return.

I want to take this time to provide my own definitions to the variables used throughout this thesis document, and for the purpose of this paper the term 'user' identifies with the targeted end user or customer of this mobile application.

- *Fits: refers to how clothes fit the body*
- *Cuts: relates to how the item of clothing is made*
- *Styles: refers to the different types of cuts in a specific category, such as jeans*

The scope of this entire thesis project, documented in this paper, is focused on assisting people to get dressed, and how to make it an easier task. Which in a larger scope, will improve user's awareness of clothing they feel comfortable wearing. Oliver Clancy from BBC completed a survey with 1,000 online shoppers to gather data on their return rate, and concluded that "two

[1] Mehta, A. (2018, July). *Where do your online returns go?* Retrieved from https://www.ted.com/talks/aparna_mehta_where_do_your_online_returns_go

thirds of shoppers who bought women's clothes online in the last six months sent at least one item back" (Clancy, 2016, para. 1).

With the complexities around getting dressed, and the variables that go into the process of putting together a coherent outfit, as highlighted previously, machine learning is the most appropriate system when it comes to the process of recommendation system. Machine learning is a subset of AI; AI is decision making and Machine Learning allows systems to learn new things from data. Machine learning uses minimal human intervention, but uses data to build and become independent[2]. This is important for the growth of this database because fashion changes quickly, and by using data with human interaction it will assist in keeping the databases built for this proof of concept up to date with fashion.

(1.3) Project Objective

How we dress reflects and mimics our human behaviour and impacts how we think about ourselves. A lot of current fashion mobile applications will recommend clothing you should purchase, based on your search history. The difference with the *What Do I Wear?* mobile application is I am taking the user back into their wardrobe and recommending outfits with clothing they already own. Rather than suggesting clothing items they should purchase when they have not solved the complexities they have when getting dressed. The objective of this format is to have the user learn about why they wear what they purchase, and best ways to style an outfit based on personal preferences. Without spending additional money to build a wardrobe

[2] SAS. (n.d.) *Machine Learning: What it is and why it matters*. Retrieved from https://www.sas.com/en_ca/insights/analytics/machine-learning.html

they feel comfortable with. The final product of my thesis research is a proof-of-concept database in the presentation of a mobile application that allows the user to upload their personal wardrobe into their virtual wardrobe and to use it to recommend outfits based on personal factors.

(1.4) Research Questions

The primary question guiding research is:

- How might data-driven technologies curate and generate complete outfits to people, from their personal wardrobe?

Secondary questions include:

- How will a recommendation system and apparel classifier system work together to create an outfit based on a specific user's factors?
- What technology is needed to make the mobile application a short and concise process for a new user and existing user, and what is the best way to display this information?
- Will variables *body shape, personal style, lifestyle, and weather* be sufficient factors to determine coherent outfits for a person's day?

(1.5) Scope and Limitations

My thesis research is about opening my skills and expertise as a personal stylist to anyone looking for assistance. I have focused the scope of my thesis research and practice on codifying the process and information I use and require to make a successful recommendation of

a complete outfit to a client. I am taking this process and information and translating it into an algorithm that can make a recommendation specific to each user.

The fundamental part of my thesis research and practice is taking those variables and building a database system which includes the recommendation system and apparel classifier system. The presentation of this database will be in the form of a mobile application to showcase the entire process of how the database works, from start to finish. The scope on the practice of this thesis is a proof-of-concept database, and a prototyped mobile application. Focusing primarily on this database with the two systems will allow me to build the front-end of the application simultaneously back-end of the mobile application, because they all work together to recommend an appropriate outfit for the user.

(1.6) Business Plan Introduction

I included a business plan in my appendices, under "Appendix A", to highlight the *what's next* of this mobile application. The *What Do I Wear?* mobile application I presented for my thesis will be the first product of my start-up business, which is a fashion focused technology company. As a start-up company this business plan focuses on our strategies and objectives in making this product successful. The key insights outlined this in business plan point towards our key partners, marketing strategies, and competitive advantage. These key insights are important components for us to focus on when developing the business plan. As we are a start-up and although we will run a lean business to build our fully functioning mobile application, we do not have the financial projections to support our projected revenues just yet. We tailored the business plan to vocalize the strategies and objectives we can back up, which is supported with our key insights.

The fashion industry is growing rapidly. “25 percent of fashion executives said that investing in brand building to increase full-price sell-through is one of their top five focus areas for sales and growth” (McKinsey & Company, 2018, p.67). The concept of brand-building is happening through the cutting-edge technology advancements being promoted. “Many fashion brands have recently made big advancements in digital, data analytics, and mass-customization in production, the prerequisites for delivering personalisation scale” (McKinsey & Company, 2018, p. 45). Using data to deliver personalization is a key goal for my business model and mobile application development. The concept of having a personal stylist and shopper available to you anytime through this mobile application is not new. However, how I am proving that machine learning is flexible and viable for human tasks makes my business model and mobile application a new innovation to brands and businesses in the fashion industry, but also for consumers.

The goal of this application is to be used by anyone looking for assistance in getting dressed. When I was working as a personal stylist and shopper, I was hired primarily by working professionals. Both male and female, with families or single. This is the demographic I am focusing to reach first, because it is common for this group of people to hire personal stylist and shoppers. Due to their busy schedules, they would rather hire someone to shop for them and build a wardrobe that makes getting dressed an easier task. Although brands such as *Topshop* to name one, are offering low cost personal stylist and shoppers services, this demographic prefers to work one-on-one with someone who has a better understanding of what they need. This information is based on personal experience and insight.

Chapter 2: Literature and Contextual Review

(2.1) Literature Review

The motivation behind this literature review is to gain further context on why getting dressed in the morning is considered a complex problem for some people. The goal of this literature review is to highlight all the interrelated parts that go into building a wardrobe that can make the process of getting dressed a simple system. I have drawn attention to professionals and theorists who study and also work in the fashion industry, like myself, and highlight the importance of how assistance and guidance to sourcing a coherent wardrobe is important to improve your confidence. For the purpose of the literature review and thesis project it is important to define *fashion* and *style*, two terms that are the most interchangeable words in fashion industry. Fashion is defined as universal trends dictated and presented to you by designers. There is no denotation for the term personal style. Personal style takes "what kind of cuts, colours, and combinations you love, how you like things to fit, and what overall style you feel more comfortable in" (Rees, 2016, p.80). Ultimately, it is about synthesizing all these findings and visually expressing your style profile, which includes: your mood, how you personally describe your style, and the overall aesthetic you are aiming to have in your outfits. One common way people look to learn about their personal style and clothing that suits it is through the system of curated closets.

(2.1.1) Curated Closets

The book *The Curated Closet*, written by Anuschka Rees, looks at the system of personal-style defining techniques. Anuschka Rees has a master's in social psychology from the London School of Economics, and has spent years studying the intricacies of human decision making. Her book focuses on helping the reader to define what their personal style is by getting the reader to find their aesthetic preferences, like colours and silhouettes, in clothing they feel comfortable in.

The interrelated parts of personal style, lifestyle, and body shape make a coherent outfit you feel comfortable in. "A great wardrobe is like a well-oiled machine that consists of interrelated parts that all work together, allowing you to mix and match freely and create a ton of different outfits that all suit your personal style" (Rees, 2016, p. 114). The art of dressing is confusing and complex because there are so many questions and concerns we have when putting clothing on our body. One method many fashion professionals assist people in putting together a streamlined wardrobe, is by teaching them about curated closets. "The Curated Closet is a wardrobe that's perfectly tailored to your unique personal style and your life. It is not based on trends, style typologies, or a cookie-cutter list of "wardrobe essentials" (Rees, 2016, p.1). Building a streamlined curated wardrobe that you feel comfortable in starts with understanding the multiple interrelated variables such as: personal style, lifestyle, and body shape.

A curated wardrobe is "a wardrobe that's perfectly tailored to your unique personal style and your life." (Rees, 2016, p.1). To start this process, is by looking to define your personal style. Personal style is ultimately shown through the clothing you wear based on your lifestyle and personality. There are people that will search for insight on how to define what their

personal style is, so they purchase clothing they love and feel good in, and will ultimately wear. "Your favourite colours, materials, silhouettes, and other aesthetic preferences are the clay" (Rees, 2016, p. 47). Focusing on the basics and understanding your personal style, how to dress for your lifestyle, what colours work for you, and dressing for your body shape will make the art of dressing for you easy and straight forwards.

Being functional is key, but that does not mean you need to be over specific in the clothing you own. "To be functional, your wardrobe needs to be optimally tailored to your lifestyle, or in other words, what you are doing all day" (Rees, 2016, p. 104). For instance, if you typically spend your day running errands, and only go out to a formal dinner once every two months then your wardrobe does not need more fancy attire than casual wear.

Most people tend to focus on shopping for their size rather than shopping for their body shape. "In addition to the fact that most designers max out at size 12, the selection of plus-size items on offer at many retailers is paltry compared with what's available for a size 2 women (Gunn, 2016, para. 4). When it comes to dressing for your body shape there are flaws in how the industry recommends clothing for your body shape. "If we are being honest, to *flatter* almost always means "makes you look thinner", and that definitely shouldn't be your prime objective when it comes to getting dressed" (Rees, 2016, p. 57). Wear cuts and fits that you feel comfortable in and prefer. "Keep an eye on what kinds of silhouettes resonate with you, as well the cut and fit of individual pieces" (Rees, 2016, p. 56).

Tim Gunn, a design educator, author and co-host of Project Runway, wrote an article for the Washington Post in 2016 on how the fashion industry perceives shapes and sizes for women in America. This article highlights the statistics of how plus size women find it hard to source

clothing that fits them, because designers are failing the mass market because they prefer their clothing to be placed on a 'perfect' silhouette. The fact that there is a plus size market for shopping is demoralizing, everyone should be able to walk into the same store and shop freely, Gunn highlights.

Colour matching is one common question when it comes to getting dressed. Colour additionally is a primary factor in how present your personality because it is a driving force in what clothing you purchase and how you match it together. It is also relevant in several other aspects like skin tone, hair colour and makeup. The theory of colour theory, and art of colour matching go back to the basics by looking at the colour wheel. Understanding the primary, secondary, tertiary colours, warm colours, cool colours, and neutral colours are how you colour match and combine colours in your look. This might sound intimidating, but there is no right or wrong answer it is just about understanding the relationship between colours.

In fashion terms we identify colour matching relationships as monochromatic, complementary, analogous, split complementary, and triadic. These terms are the only ones you also need to know and understand. Monochromatic "is a colour combination that is comprised of just one color" (Klug, 2013, para. 13). Complementary "are the colour that are directly across from each other on the color wheel. Because of their high contrast, as the name implies, they complement each other the most out of any colour combination" (Klug, 2013, para. 14). Analogous is the "combination of any three colours that are directly next to each other on the colour wheel" (Klug, 2013, para. 15). Split complementary "is found by taking a base colour then pairing it with colors directly next to its adjacent color" (Klug, 2013, para. 16). And lastly is triadic "are groups of colors that are equidistant from each other on the colour wheel" (Klug, 2013, para. 17), think vibrant and choosing a base colour with accent colours.

(2.1.2) Psychology of Fashion

The clothing we wear reflects our mood. “Clothing and appearance play an important role in the development, maintenance, and modification of the self and are part of the way we view and think about ourselves.” (Mair, 2018, p. 58). Understanding human psychology is crucial when it comes to recommending clothing and identifying body shapes to someone. “We dress for many reasons: to protect and adorn the body, to extend its abilities and to communicate psychological and physical aspects of our self and identity via nonverbal, visual communication.” (Mair, 2018, p. 91). Getting to the root of what you wear is important, “‘mood enhancement theory’: how an item could amplify positive emotions.” (Miller, 2018, para. 3).

Dawnn Karen is working fashion psychologist who works in a similar way as a personal shopper/stylist but digs deeper into sourcing why her clients are purchasing items they don’t wear. The insecurities of self-image and self-perception can have a negative impact on anyone. And a lot of this comes from the clothing we wear and how we behave in it. “Negative body talk or fat talk is related to perceptions about the self and to appearance-management behaviours in presenting the self to others” (Johnson, Lennon & Rudd, 2014, p.15).

Carolyn Mair’s book, The Psychology of Fashion, looks into case studies and statistics on how fashion affects and effects human behaviour. From designers to models, and consumers fashion people’s self-identity is being impacted. Dawnn Karen is a working fashion psychologist, who has been featured on multiple publications and networks for her research and theory on Fashion Psychology. She is also the founder of the Fashion Psychology Institute and CEO of Fashion Psychology Success and The Fashion Psychology Field.

(2.2) Contextual Review

(2.2.1) Related Projects

(2.2.1.1) Mobile Application: Stylebook

Stylebook has the similar qualities of uploading a virtual wardrobe, dressing appropriately for the weather or your lifestyle, and putting together outfits for you the user.

The downside to the wardrobe upload on the Stylebook mobile application is the user still styles outfits together. This mobile application does not use any form of recommendation, the user style their own outfits pulling clothing from their virtual wardrobe into a collage screen so they can save outfits. When the user wants to get dressed, they can look at their saved or scheduled outfits they styled themselves. Additionally, when uploading an item of clothing into the application, you still have to record the information about the item of clothing. For most people this is time consuming to do.

(2.2.1.2) Mobile Application: DressingRoom by GAP

The fashion world is starting to experiment with the technological advancements that are being introduced into our everyday lives, specifically when it comes to online shopping. Fashion companies and brands are starting to envision and use these technological forums as a way to engage with their customers and increase sales. The Gap is one brand that is using augmented reality to drive sales. They released a mobile app called “DressingRoom by Gap” for customers to try on clothing in a virtual experience using their virtual avatar. The conversation around how clothing is supposed to fit different body shapes is an ongoing one. Gap is using this application

to get people to understand how clothing fits, in a true and honest manner, so when products are delivered to customers they will feel good about what they have purchased because it fits.

The precise measurements are important when fitting a customer because it can push the customers towards feeling confident or uncomfortable, which in effect affects their psychology. The process of how they do this by asking the height, weight, and bust of the customer will not input a precise measurement, as there are many other factors that fall into the cut and fit of clothing. Height and bust measurements do play a role, but asking for someone's weight can give incorrect possibilities on how the brand might fit you.

(2.3) Current Landscape

(2.3.1) Fashion Industry: Consumer Behaviour

The Business of Fashion stated that, "$1 trillion is estimated to be spent by global consumers on cross-border e-commerce by 2020" (McKinsey & Company, 2018, p. 32). Traditional brick and mortar retail stores are suffering with the traffic because online companies like Net-a-porter and Amazon are succeeding because customers are preferring to look online for items to purchase over going to the store. Now with businesses looking to re-evaluate and grow their online presence to grow their sales, they are looking to improve the personalization online similar to how it should run in brick and mortar stores. In 2018 the fashion industry is looking to create a new sense of optimism around personal tough. "Fashion companies will deliver personalization in many forms – from more-customized products, to curated recommendations, to communication and storytelling that connects to individuals" (McKinsey & Company, 2018, p. 44).

McKinsey & Company has "identified tend major trends that we expect to shape the fashion industry in 2018. These ten trends fall into three main categories: the global economy, consumer shifts, and changes in the fashion system" (McKinsey & Company, 2018, p. 24). Retail companies such as Net-a-Porter, SSENSE, and of course Amazon are raising the bar for the modern-day shoppers, because they are making cultural and behavioural changes to how their customers shop. "This is a generation that has higher expectations on what a company should be able to deliver: convenience, quality, values orientation, newness – and price" (McKinsey & Company, 2018, p.17). Consumers in the fashion industry are changing, as fast as the innovation in the technology world.

Fashion revolves around personalization. We purchase clothing we like, and style it to match our personal style. The concept of one-on-one is something we all yearn for. We look for it when we are in physical stores shopping, and customers are starting to request it towards online stores. "Increasingly, consumers are trusting others to curate the information for them" (McKinsey & Company, 2018, p. 45). With the influencer market of advertising becoming a popular way for customers to gain inspiration on what to purchase and how to style it, customers are looking for this similar concept when they shop. Others are looking to digital operations and capabilities recommended products based on the consumers search history and click history on social media as one example. There are now systems in China, "allowing users to generate outfit matches from hundreds of items, like a personal stylist" (McKinsey & Company, 2018, p.50). Customers want tailored and customized recommendations and solutions to their shopping. "Today, only 10 percent of startup companies consider machine learning to be a core business say they generate revenue" (McKinsey & Company, 2018, p.60). Customer experience is the frontier to building a strong and reliable business. ">75% of fashion retailers plan to invest in AI

in 2018/2019" (McKinsey & Company, 2018, p.27). Machine learning is being employed into a number of ways to the fashion market, for the benefit of the consumer and the sustainability of fashion businesses. The mobile application I have built for this thesis project requires machine learning to solve a core business problem, being we over purchase to build a wardrobe that suits our personal style, lifestyle, and body shape however our over purchasing habits are impacting the simple task of getting dressed and our environment. This mobile application additionally has the potential to generate revenue.

It is clear that businesses are investing and deploying these technology advancements for the customer, but consumers are welcoming these AI advancements too. In the study "What do Americans think of artificial intelligence?" completed by Stephanie Jorgl from Conversica, she completed a poll with over 1,000 Americans "to determine how they view AI and whether they believe embracing it will ultimately help or hinder them in their careers and in their personal lives" (Jorgl, n.d., para.1). The study concluded that three out of four Americans believe AI to have a positive influence on their lives. "AI can lower time spent on repetitive tasks and free up individuals for more rewarding activities" (Mulqueen, 2017, para. 2). Business are keeping up with the trends that consumers are looking for. "Businesses are implementing the technology, consumers are reacting to it, and businesses are then reacting to the consumer's reaction" (Szatylowicz, 2019, para. 28). For machine learning and AI to be productive, there needs to be human interaction. It is essential to build human produced data through interaction, so it is important for consumers to feel welcomed to this technological advancement.

(2.3.2) Technology in Fashion

Technology is transforming the fashion industry in a number of ways. I do not want to focus this section on the battle between brick and mortar versus online shopping because I want to talk about the specific new technology advancements brands and companies are introducing in both physical and online locations. The fashion world is changing and evolving quickly and technology is allowing fashion companies to push the way people connect with their clothing in a digital way. Louis Columbus, a contributor at Forbes, wrote a statistic that "90% of retailers will implement buy online, pick up in store by 2021" (para. 1). With eight out of ten customers prefer to shop online than in store, it is from statistics like this that companies are wanting to build an integrated relationship from their brick and mortar store to their online store. The common goal all brands and companies want for their business is to improve their customer experience, and one way this is happening is through technology advancements.

The top advancements that are being introduced into fashion are, Internet of Things (IoT), artificial intelligence (AI), mobile commerce and virtual and augmented reality. These new digitized advancements are wanting to revolutionize how businesses operate and improve on customer experience. Kim Kardashian created an application called Screenshop, that allows you to screenshot a look you like and find similar products at any price. This application uses AI to pull information from a photo, like colour, fabric and cut to name a few, and work as a personal shopper to assist in finding looks for you.

The largest tool companies are introducing to monetize their brand is IoT. IoT is like wearable technology. Nike created a shoe that allows you to track your running performance on your smartphones. "Visa will be using IBM's Watson IoT platform to allow developers add

mobile payment technology to devices and also talked up the prospect of a pair of shoes embedded with a chip that alerts runner's fitness tracker letting them know how many miles they've logged and when it's time to buy a replacement pair" (Sawh, 2017, para. 4). The benefit from a business perspective is for companies to understand their consumers needs and wants, which in turn improves customer experience.

AI is the other tool that is creating a buzz in this and many other industries. Companies are using AI to gather data, analyze and sort through it to better understand and predict what customers are looking for when they shop. Lastly, virtual and augmented reality. This type of technology is introducing a new wave to the concept of shopping. These platforms are bridging how we shop in physical locations and online. With online shopping hurting our planet with the amount of clothing going to the landfill per year, this technology is looking to assist in having customers purchase items that are equivalent to their expectations.

Chapter 3: Research Methods

Through my working experience I identified a problem in the fashion industry, being that getting dressed is a complex issue, because some people are unsure of what fits them and what they feel comfortable in, so they leave their homes feeling uncomfortable and not happy with the clothing in their wardrobe. Which points to a larger picture being: shopping for clothing can be a frustrating and not enjoyable task.

By taking this problem and breaking down my expert experience in the field of personal styling, I designed an application that will work as your own personal stylist, and in the future your own personal shopper. I am applying my expertise, not my experience, on the subject matter of being a personal stylist and shopper. My research methods are taking on a top-down methodology, interdisciplinary collaborative process, and using the method of expert consultation.

(3.1) Methodology Framework

(3.1.1) Description

The approach I will be using for my practice is a top-down methodological framework with an interdisciplinary collaborative process, and the practice of reflexivity. The top-down framework is similar to a product management framework. “In particular, designers, software developers, and engineers are drawn to the top-down policy because reverse product engineering often leans to the best final outcome” (Smartsheet, n.d., para. 8). I came to OCAD University with an idea for my thesis project and a concept for a solution, but needed to learn more about

different types of technology to understand the best way to turn my solution into a reality. A top-down methodology framework works by having a vision and breaking it down into smaller segments to build the bigger picture you started with. For this application to work, the planning stage takes the most time and focus to develop, over the coding development of the application. I was able to focus on the machine learning back-end design which is the recommendation system database. The planning process is the phase that takes the most time to create and develop before the project cascades down to the development phase. Using this framework has an advantage especially in AI. Some developers in AI will use a bottom down methodological approach, however for this thesis project it is more suitable to use a top-down methodological approach. "Essentially the top-down approach will develop a system that has preprogrammed definitions on cognitive responses analytical intelligence" (McLean, 2018, para. 2). The AI back-end system I built is incorporating knowledge from myself to function and work, and recommend an ideal outfit to the user. Using this framework for both my research, practice, and business strategy allows me to include details in every layer of abstraction.

I am additionally using an interdisciplinary team to my practice, because I wanted to focus on the function of the application, which is the AI apparel classifier system and recommendation system. Thinking about what fits and clothing cuts match together is my expertise, where developing an application is not. I focused my research and design practice on building a database that thinks similar to how I would when styling someone in an outfit. To make my database into a working product for the intended demographic, I need a team to work with me on components that are not my strong abilities. By using an interdisciplinary design team, it will bring a depth of learning to my research because diverse knowledge and skill sets

are brought together to create valued research and result of a sustainable system, product, or business.

During my research and practice I used the practice of reflexivity to take myself out of the researchers' perspective and into that of a user. "Our behaviour will always affect participants' responses, thereby influencing the direction of findings" (Finlay, 2002, p. 531). Using the practice of reflexivity offers the research and final mobile application to have integrity and trustworthiness because it looks at the moral dimensions of the product. "Researchers demonstrate how they have proved the influence of their thinking and responses and how they have used reflexive analysis both to gain insight and as a tool for evaluation" (Finlay, 2002, p. 536).

(3.1.2) Process

The process of using my top-down methodology allows me to focus on my expertise and focus on the building of the database, for the developers to code a working prototype. I additionally have worked on the business plan with my business manager and business financial advisor. The planning stages in this framework is important, and as the expert and project manager of this project the process begins with the planning. My process for this looks at what I consider important variables, how I think when working with my clients, and how I can incorporate how I think into machine learning. Through writing notes about my personal process, guidelines, and steps for when I am assisting someone in purchasing a new wardrobe I identified important parts that need to be considered when my application uploads clothing and recommends outfits to the user.

(3.1.2.1) Importance of Understanding Personal Style

Style is unique, fashion is not. The clothing from fashion brands we purchase is available to everyone, but how we style our clothing items makes it personal. We dress to visually represent our personality and mood. It is one way we can showcase who we are and what we stand for, before we verbally communicate. Two people can purchase the same t-shirt and wear it in completely different ways. This is what makes style unique. The colours we select, the patterns we connect with, and the silhouettes we purchase are variables that's are styled together to showcase who we are. "Sometimes it's not the individual pieces that draw us to an outfit, but its overall feeling" (Rees, 2016, p. 55). It takes time to develop *our look,* and it evolves over time.

Describing your personal style can be done in a number of ways, as there is no right way to describe your personal style. You can define your personal style by the different cuts or fit of clothing you wear, or how much or little colour you wear in an outfit. You can explain your personal style with a number of words, or a single word. Personal style is personal. You have the ability to define and describe your look any way that you want. This is what makes personal style complex when you are trying to assist someone in dressing. There are other variables that go into sourcing someone's personal style, like their lifestyle. One way you can start to understand how to describe your personal style is by how '*daring*' you are with colour and patterns. For instance, if you dress with more neutral and tonal colours then your personal styling is not daring. If you wear accent or vibrant colours with your neutral main colours your personal styling is moderately daring. If you are someone who's colour matching in their outfit is vibrant and eclectic with colours and patterns your personal style would be daring. This is one method to

look at when you are starting to describe your personal style, and the clothing that works for your overall look.

(3.1.2.2) Importance of Understanding Body Shape

Talking about body shape can be uncomfortable. It is a topic many people bypass and do not mention when talking about clothing. This lies in the dominant societal emphasis on lean body frames and small dress sizes. The fashion industry focuses its designs and styles on their idea of the *'perfect shape'*. "Sure, at New York Fashion Week in 2015, Marc Jacobs and Sophie Theallet each featured a plus-size model, and Ashley Graham debuted her plus size lingerie line. But these moves were very much the exception, not the rule" (Gunn, 2016, para. 2). What it often overlooks is the fact that we all have perfect shapes that work for fashion, style and clothing. The Body Positivity Movement, on the other hand, a societal movement aimed at removing stigmas around weight and promoting body acceptance. "Body positivity is more than weight acceptance, though. It is about accepting one's body as it is, regarding of what is deemed socially acceptable or beautiful: from the external like acne, body hair, cellulite and stretch marks, to the more complex like physical disabilities or disorders" (Salam, 2017, para. 11). There is still a loss of connection in knowing what fits your shape. We tend to associate our weight and beauty with what the fashion industry tells us our size is. The conversation the fashion industry does not share with customers is that size does not always resemble the fit of the clothing.

Sizes differ from season to season, designer to designer, brand to brand. Before you can know what fits your shape, you have to experiment. Body shape like personal style is unique. It takes time to understand your silhouette and not necessarily how to dress for it, but how to feel

comfortable in your own skin with the clothing you put on your body. We tend to over purchase clothing, which is not only damaging our bank accounts, but is hurting our planet to have clothing that fits.

Chatting with the owner and founder of ShopGirls, a local Toronto boutique that vocalizes the motto of 'shopping for your shape', additionally agreed with myself that weight is not something to ask people because there are too many other more important factors, like the outline of someone's body. Factors like shoulder width and hip width play an important role. This is because from season to season and brand to brand the average person will change their sizing. From this expert consultation framed the 'shape' step on the mobile application to have the user identify how their shoulders and hips align. This avoids asking personal information, and starts the building of body shape on the database.

(3.1.2.3) Body Shape and Size

In the late '50s the government wanted to create clothing based on a standard dimension scale for the average American. *At this time Marilyn Monroe was their standard, with a 35-inch bust and 22-inch waist, otherwise known as a size 12. Based on her measurements she would be classified as a size 6 based on the today's standard dimension scale* (Nguyen, 2015, para. 5). The standard size measurements in the 1950s are not equivalent to the sizing in the 1970s, 2011, or present-day. This is why in 1983 the government decided to ignore a global standard size dimensions for clothing. Our current era has introduced what designers and manufactures use now, vanity sizing. "Today, clothing manufactures are often using "vanity sizing," the labeling of clothes with sizes smaller than the actual cut of the items" (Dooley, 2013, para. 2). This means manufactures assign smaller sizes to articles of clothing to encourage sales. Generally speaking,

if your waist measured 28 inches in the 1970s you would wear a size 4, but in the 2000s if your waist is 28 inches you would wear a size 12. With vanity sizing manufactures have increased the waistline for you to fit back into a size 8. “Clothing manufacturers realized that they could flatter consumers by revising sizes downward” (Ingraham, 2015, para. 9). Manufactures and brands have done this to increase their sales because who doesn’t feel confident when they downsize? The downside to this, is that it is a false statement, but also inconsistent from brand to brand. The New York Times archived graphic in *Figure 2* from 2011, Whose Size 8 Are You Wearing? that shares how size 8 waist measurements can differ up to 5 inches of fabric from brand to brand. For instance, Gap Inc. has three brands under their company: Banana Republic, Gap, and Old Navy, and each of them have different measurements for their clothing. *“A size 8 hip at Banana Republic equals a size 2 hip at Gap”* (The New York Times, 2011, n.p.). The thought of having to identify your shape to a single number or letter can bring forth self-esteem issues. What consumers tend to not know about size in fashion is the variety it has. From country to country, brand to brand, designer to designer, and even season to season size can change. It is reasons like this people, especially women, find it frustrating and time consuming to find something that fits.

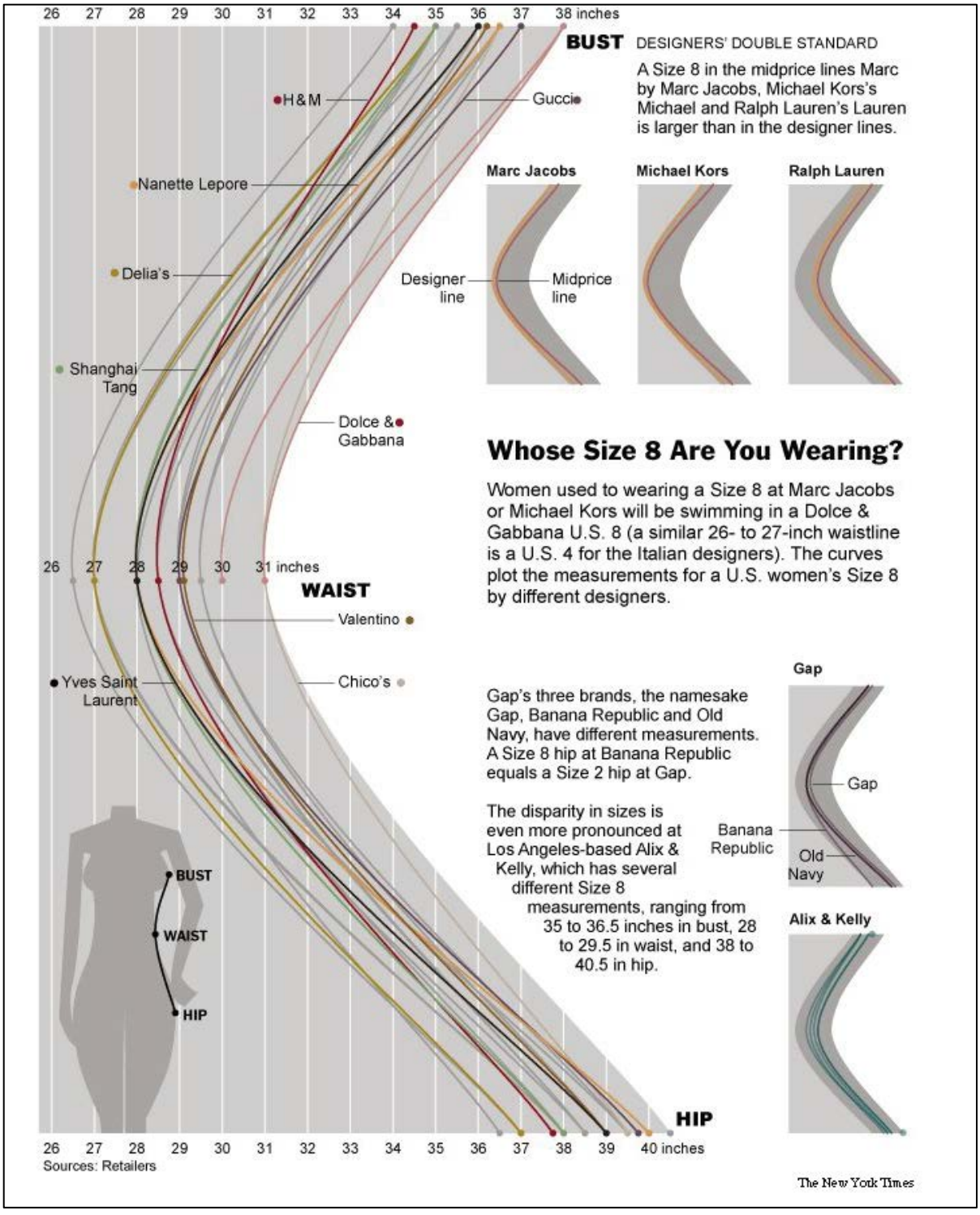

Figure 2: New York Times, Whose Size 8 Are You Wearing?

(3.1.2.4) Importance of Understanding Lifestyle

The clothing we purchase is based around the lifestyle we live. We select items and style outfits that fit the activity we do on a daily basis. If you do not attend a lot of black-tie events why do should you own 10 black dresses or numerous suits. Our lifestyle plays an important role in all the decisions we make. In fashion we select clothing that works for us every day, typically. If we tend to walk to work or take transit we will wear something comfortable on our feet and maybe change shoes when we get into work. However, some do tend to over purchase items that we *can see ourselves wearing,* but never do. This a common strategy personal stylists and shoppers use, if you can come up with five outfits of how you would wear the piece you are looking to purchase, then get it, because you will work it into your outfit shuffling. If you can think of an outfit to wear with this new item, chances are it works for your lifestyle.

(3.1.2.5) Process of Getting Dressed

When it comes to getting dressed, there is a range of different things people consider before they find the perfect look. Some of the most common considerations the average person will look at before selecting their outfit is, weather, what occasion or activity am I dressing for, is it clean, what is my mood, and will I be comfortable? Others have different considerations before selecting clothing from their wardrobe like, what undergarments they might be wear or others don't have a system. It is a process that guides us in styling the perfect look we feel comfortable in all day. In the book "Women in Clothes" by Sheila Heti, Heidi Julavits, and Leanne Shapton they completed a survey that asked a question to explore the process of getting dressed for women, *37. What is your process getting dresses in the morning? What are you considering?* I used this survey to gather information from women to see common processes. This is again a

personal decision we make, based on 'the getting dressed' process we have designed that suits our lifestyle. How we look is a personal feeling, though we sometimes forget this. When you like your outfit, you feel confident, which makes you feel good. Thinking about your getting dressed routine will determine, like personal style, how you select items and put them together. This is information that links to our personal style and how we layout all the clothing in our wardrobe. Make your wardrobe fit your process of getting dressed. Make it easy on yourself to select the clothing you want to wear for the day.

I focused on creating a system that looks at styling outfits based on: fits, cuts, styles, necklines, waistlines, sleeve lengths, colours, and how to dress well for the weather and daily activity. Going through the process of how I work and think when styling outfits for my clients, it assisted myself in being able to create something manageable, do-able, and that highlights the overall goal of this product. Additionally, I broke down the versions of the mobile application from what I will present for my thesis to the later versions. This method relates to my practice because it is understanding my context, scope, and limitations on what is viable to present.

I built wireframes as a starting design, and have then passed them to my UI freelance designer where we talked about what needs to be on each page, for the new user side and existing user side of the application. This was a three-stage iterative process. My top-down methodological approach is similar to that of both an agile and waterfall process in project management. "Agile was originally developed for the software industry to streamline and improve the development process in an effort to rapidly and adjust for issues and defects" (Alexander, 2018, para. 5). I work and focus on planning the design and relationship of the database, and questions that need to be asked to run the database, and then work with people whose professional experience is in coding what I focused my research and practice.

(3.1.3) Reflections

There was more thought that went into designing the back-end system than I originally conceptualized. I assumed it would be straightforward in categorizing fits and cuts, including different styles of cuts, and the matching of those because that is what I do for a living. However, I need to spend quality time and critically think and understand why certain fits, cuts and styles match together to make an outfit. I did not realize how much of my 'thinking when styling' is second nature to me. When I first started to work on the database in note form, I was adding in a lot of different cuts and fits. For instances, in sleeve lengths I originally started with up to 10 options. From short sleeve to bell sleeve, to strapless and 1/3 quarter, and many in-between. This got too complicated. So, I had to slow down and think about what mattered when styling someone. This list included the basics of clothing design. When thinking of an upper body item like a blouse, I would look at the fit, waistline cut, neckline, sleeve length, and then the colour. With each of this categories I simplified the subcategories that linked to them. Continuing with my sleeve length example, I cut it down to five options. Being, 1/3 length sleeve, cap sleeve, long sleeve, short sleeve, tank top sleeve. Even though there is bell sleeve or balloon sleeve options in a long sleeve style cut I had to think simple to build this database well and smart for this prototype at least. I did this with all the different fits, cuts and styles I included into the database system.

Another component of the database that involved a lot of planning was how to link and include personal style into the database. Again, it was something that I had to simply and think in a way that a computer would. As this was very second nature for me to style someone and get their personal style without having to even ask how they would describe it. Additionally,

describing your personal style is difficult for a lot of people. Some people will mix and match words and others will have one solid answer, or others will have no idea what words describe their personal 'look'. Based on a lot of thinking and chatting with past employers of myself, I was able to figure out a way to link personal style to this database. That is with colour. For now, it makes sense with how people will dress. They use colour as a way to reflect their personality and mood. This was also the more difficult design process I had to think about on the front end. In the end, I designed something that focuses on many components that go into styling an outfit.

(3.2) Methods

(3.2.1) Description

It is important to highlight I am not an expert when it comes to system design. I am taking my expertise on personal styling, and taking the methods I use when styling an outfit for someone and making this into a system. I am using expert consultation to guide myself in to building a database that uses the same critical thinking I do when styling an outfit.

When building a product that answers my research questions, I was able utilize my professional expertise on the subject of fashion styling and using expert consultation as a method on subjects I am not an expert on or need further advisement on such as: machine learning and marketing strategies and financial analysis in business.

I completed a brief reflexive process during this thesis project, to take notice of the credibility, transferability, dependability, and confirmability of the research completed and mentioned in the documentation. The conversation on ethical dimensions in both data-driven

technologies and the fashion industry is a reality people think about. As the role of the expert in fashion and style, but also as the researcher for this thesis project I have accounted for my stance on the decisions made when working on the practice of the mobile application.

For me to turn my knowledge on styling different fits, cuts and styles together, into a recommendation system needed expert consultation. Through faculty at OCAD University like Marcus Gordon and Adam Tindale, and students Roxanne Henry and Orlando Bascuñán, I was guided through on how to build a normalization database. I wanted to have the control on building the recommendation database because it links to how I think as an expert. Once this was finalized I was comfortable to pass it onto a developer to code it. I connected and networked with professionals in fields like technology development and psychology where I needed to learn more about the subject matter. I am working with Hammadullah Syed, who is a freelance designer for UI design, and a team of programmers from Foremost Digital.

For my business strategy and plan I consulted with Kelby Price who is the Vice President of Corporate Development with Labrador Technology, Inc. in Calgary. Her skills in the technology community identify with marketing strategies, investor relations, and financial analysis. Kelby Price's professional input for the growth of this application, from a business perspective is ongoing. We looked at the current landscape of the fashion industry, and how it is merging with the technology industry, to see if this would be a viable product in the mass market. We focused on understanding and research on possible competition to see what is out there that people are using, and how we can make this mobile application stronger when it comes to assisting people in getting dressed.

(3.2.2) Process

I used my connections at OCAD University to begin turning this idea into a viable product. I learnt about technology from the back-end like: app development and machine learning. From here I sourced faculty and students that focus on these different technological advancements to figure out the best way to build this system.

For my product, I focused on researching and building the recommendation database system which connects to the apparel classifier system. I decided to work and grow my design team in formulating the finalized prototype version. I completed expert consultations and hired a user interface designer and a programmer. My user interface designer is assisting in formulating the connection between each page, and the design aesthetic, and is assisting on specific fundamental components like Colour Theory. We are working as a team on this. I sketched and designed wireframes for how I want this application to work and connect with the back-end system. Working with a designer has assisted me to understand how mobile applications run and work. I chose this as the best method to take because I want to create a well-designed prototype, I have a vision and want the best version to come out of that. This is additionally an interview process, because I am working and chatting with experts in fields such as user interface design. We brainstorm based on the designs and processes of the application I outlined, and talk about the best result.

For the development of the mobile application I am working with a technology company to design this first version being presented for my thesis project. From a business perspective this is useful for me to build a networking team for when I want to make this application available to the mass market. I am focusing my building the back-end database and system design, otherwise

known as the apparel classifier system and recommendation system. Once this was completed I worked with the developers to design the final database, and for them to code it. We are working together to build and formulate a working system. Understanding their methods as much as mine is important in this case, as someone who has a goal and a vision but is additionally researching while building, I want to work with someone who can guide myself into creating a working product. I designed the back-end system for them to use and format into the proper language needed for the system to work. *Figure 3* shows my complete methodological and method process when it came to my research.

The interpretation of the data used to recommend outfits to each user is all based on personal experience working in the field of personal styling and shopping. The dataset is designed to however learn from each user about best ways to recommend outfits. The dataset considers the categories, subcategories, and attributes of each clothing items to take in and one day product similar attributes such as fit, cut, and styles to each user. The assumptions of this mobile application are only identified based on what the user inputs to the front-end of the system. The back-end will work with what is selected by the user. As the researcher, I completed a reflexivity analysis on this process by thinking about my position by putting myself in the consumers interaction with the application. Placing myself as the consumer in this process I concluded that the mobile application did not make myself feel that I was sharing too intimate of information about my style, because the application is working with what I already own. As this researcher it allowed me to reflect and conclude that the user of this mobile application will not be put out of place because they have the control to like or dislike the outfits recommended. And through the data shared about what the user feels comfortable in and does not, it will work to recommend outfits the user feels comfortable wearing. In a similar way to when a user likes or

dislikes the complete outfit they put on during their getting dressed routine without using this mobile application. This is where behind the scene questions and thoughts started to come to fruition about the ethical stance of gathering data to sell it for the benefit of the consumer.

Once the concept and output goal of the mobile application was decided, I connected with Kelby Price to assist in sourcing me a developing team to build the mobile application. Through our conversations she additionally consulted myself in what is important to build from a business perspective, and what can be worked on later before the launch of the application. She guided me to think that I need to build something that will show investors this is a new technology advancement, but is beneficial of the public and for brand partnerships. This guidance made my decisions to focus on the back-end system a good decision to make.

The development of the business plan for this mobile application was derived from my recognition of the gap in the mobile application market for artificially intelligent personal stylist. When looking at the market for fashion focused mobile applications there are various mobile applications that recommend clothing items you should purchase based on your search history, or by taking an image of a garment of clothing and having an application source you an identical or similar item. These recommendation systems are run as personal shoppers, not personal stylist. This was a market void, and a major angle I honed in on when developing the business plan with my business collaborators. For the presentation of the business plan, I selected templates that allowed me to focus more on the nature of this business, service of this mobile application, the competitive advantage we have in the market for both mobile applications and fashion focused mobile applications. Using the Business Model Canvas, was the overarching template that allowed me to focus on presenting the information I needed to in my business plan. I additionally used the S.W.O.T Analysis and M.O.S.T Analysis to identify the strategic planning techniques

used for our company. Identifying the strategic techniques is important because as a start-up and personally funded project to-date, we do not have the numbers to present our business plan with a template that focuses on the financial projections. This template allows us to vocalize the key features this mobile application will have on the benefit of the users and fashion brands.

(3.2.3) Reflections

Through expert consultations with my professors at OCAD University I was able to connect with a strong UI designer who understood what I was wanting to create and could understand the fashion side enough to create something that worked and made sense. They all taught me how to think from a back-end to a front-end way when designing. This assisted in me being able to chat with my developers and understand what they were saying when talking about the best tools and systems to use when building my application, and for me to guide them in how I want it to be done.

After connecting with Kelby Price through personal connections it aided my ability to see the growth of this mobile application, but looking at the possible monetization capabilities. She has advised myself on the technological current market, and how to target people in building this mobile application to make it an exciting product for both retail brands and their consumers.

My ethical practice is to gain trust from our users by making them know and feel they are in control, and have all knowledge of what is shared to our key partners. There is a rational behind the decision made as a company and team, again all for the benefit of our consumers. The reality and goal of this mobile app is to assist with getting dressed, and build a wardrobe that works for the independent user. The data being pulled to share with fashion brands is category,

subcategory and attribute based. The information being gathered and sold is similar to data that retail stores keep on file when you purchase an item. We are going one step further in taking this information to understand what fits, cut, and styles work for consumers body shapes and personal styles. So, when you as a consumer walk into a store the sales associates will be more capable in assisting you to purchase clothing that you feel comfortable in. This is our goal, to assist and make getting dressed and shopping a more personalized experience based on the data we received through the mobile app.

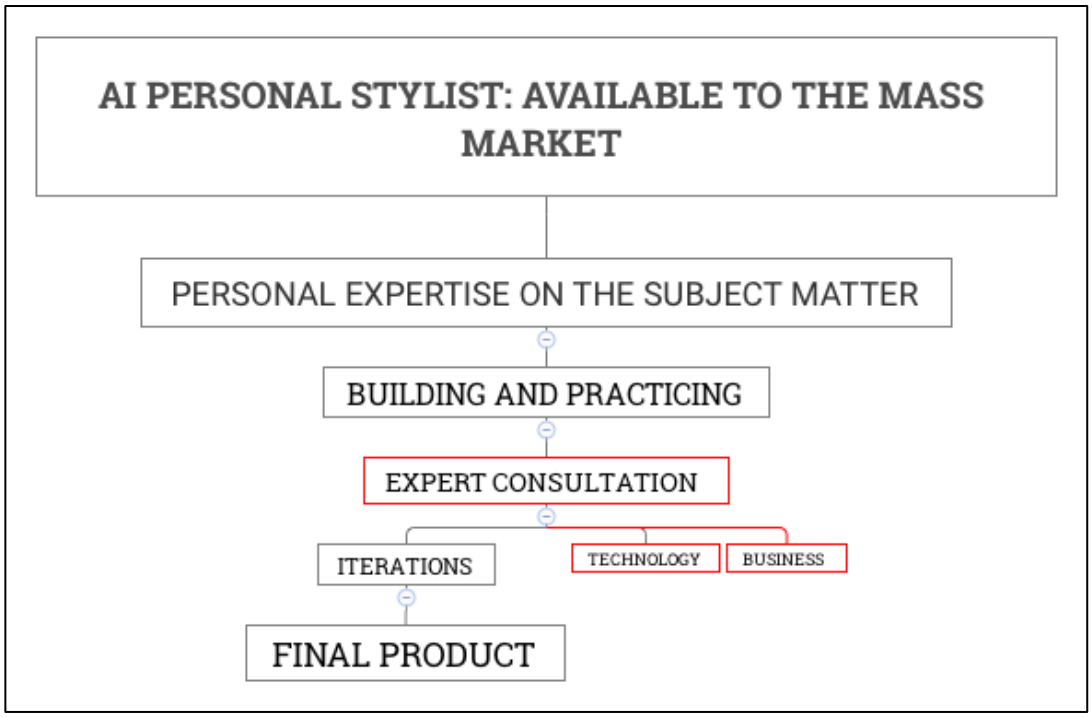

Figure 3: Methodology and Method Process

Chapter 4: Documentation

(4.1) Before

(4.1.1) Description

The focus for my thesis practice is taking my expertise in personal styling and building a database that incorporates all my critical thinking, that can be in for format of a mobile application so the end result is having a complete outfit recommended to the user. I started this journey by thinking about the grandest idea of how to make my expertise available to the mass market. I originally wanted to make my skills available while customers were shopping in large department stores. Instead, I designed a concept around this idea and did a utility patent which is now pending. My provisional US patent application was filed on October 22 2018, and a regular patent application will be filed before October 22 2019. It cannot be disclosed publicly till after a regular patent has been disclosed and approved. Due to time, scope, and limitations I worked on developing an idea that is attainable, and will link to my utility patent when it becomes available.

(4.1.2) Process

After identifying my problem, it came apparent that I wanted to take people back into their wardrobes to have them learn about the clothing they own and feel comfortable in; and assist them in the process of getting dressed. I needed to do research on how to take my critical thinking in styling an outfit and teach a machine to think like me. This is where I focused my research on machine learning. Through this research I needed two database systems, one being an apparel classifier system and the other a recommendation system. These two database systems

are the focus of my thesis exploration because they are answering my research question, that I can build a data-driven technology to curate and generate complete outfits. Through the apparel classifier system and recommendation system the mobile application can suggest a complete outfit to the user it is dressing.

Doing this research has allowed me to decide on the three most important factors that go into putting together an outfit which are: body shape, personal style, lifestyle, and weather. The first process in the framework of these databases, is the apparel classifier system. This system identifies the clothing item you are uploading into your virtual wardrobe. “Our apparel classification mechanism consists of two parts: one part describes the overall type/style of clothing, e.g., \suit", \dress", \sweater"” (Bossard et al., 2012, p.3). The dataset designed for the apparel classifier system works by identifying important attributes that go into labelling clothing items and variables that people use when selecting clothing items that fit them, and matching clothing items to create an outfit. The data picked up by the apparel classifier system will work with the recommendation system to run a process of elimination on what items should be recommended to that user.

(4.1.3) Reflections

Scoping down was a good process in thinking about the elements that mattered and that are fundamental to the end term solution I have for the start of my company. I needed to think about the components that should go into these databases because I need the system to think like myself.

Focusing on these components for this prototyped version one was a good starting point for the entire goal of the mobile application and, in later terms for my utility patent product. This process allowed me to think and utilize my time to a strong solution and product for my thesis and start into my company. Additionally, by scoping down this product to build a recommendation system with the users pre-existing wardrobe will build trust with the user by recommending outfits with clothing they already own and feel comfortable in. And not by making people feel like they need to purchase new clothing items, to build a wardrobe they feel comfortable wearing. Though, trust in the personal shopping side of the mobile application will come later and is highlighted in the business plan in Appendix A.

With my clients, I build trust and a repertoire with them by going through the clothing items they already own and assist in showing how to style outfits based on their body shape, personal style, and lifestyle activity. From here, we source the gaps in their wardrobe and I will take them personal shopping to fill in those gaps. This process is the goal of this mobile application. Currently, it will focus on the scope of being a daily personal stylist to assist the user in getting dressed.

(4.2) During

(4.2.1) Description

The next step in my research practice was to test my research and method of critical thinking to see if these databases would be able to recommend an outfit, similar to how I do as a person. The during stages focused on the step by step development I completed in building my database for the apparel classifier system and recommendation system. While always focusing

on my final goal: anyone looking for assistance in getting dressed can use this application because it will recommend a complete outfit to the user based on preferences such as body shape, personal style, lifestyle, and weather.

(4.2.2) Process

I built a taxonomy tree to identify the categories, subcategories, and attributes when it comes to identifying clothing items. This includes garment groups such as: upper body and lower body, clothing items such as: shirts or pants, and attributes such as: colours and patterns, fits, cuts and styles. “The relations within cloth types taxonomy are utilized in order to detect similar cloth types” (Frejlichowski, Czapiewski, & Hofman, 2016, p. 17). By building this taxonomy tree it became clear on how to identify rules, and what data needed to go into both the apparel classifier system and recommendation system.

I worked through this process and identified the best way to group different clothing items, designing recommendation system and apparel classifier was straight forward. *Figure 4* shows the taxonomy tree from the mind map, process and turn out.

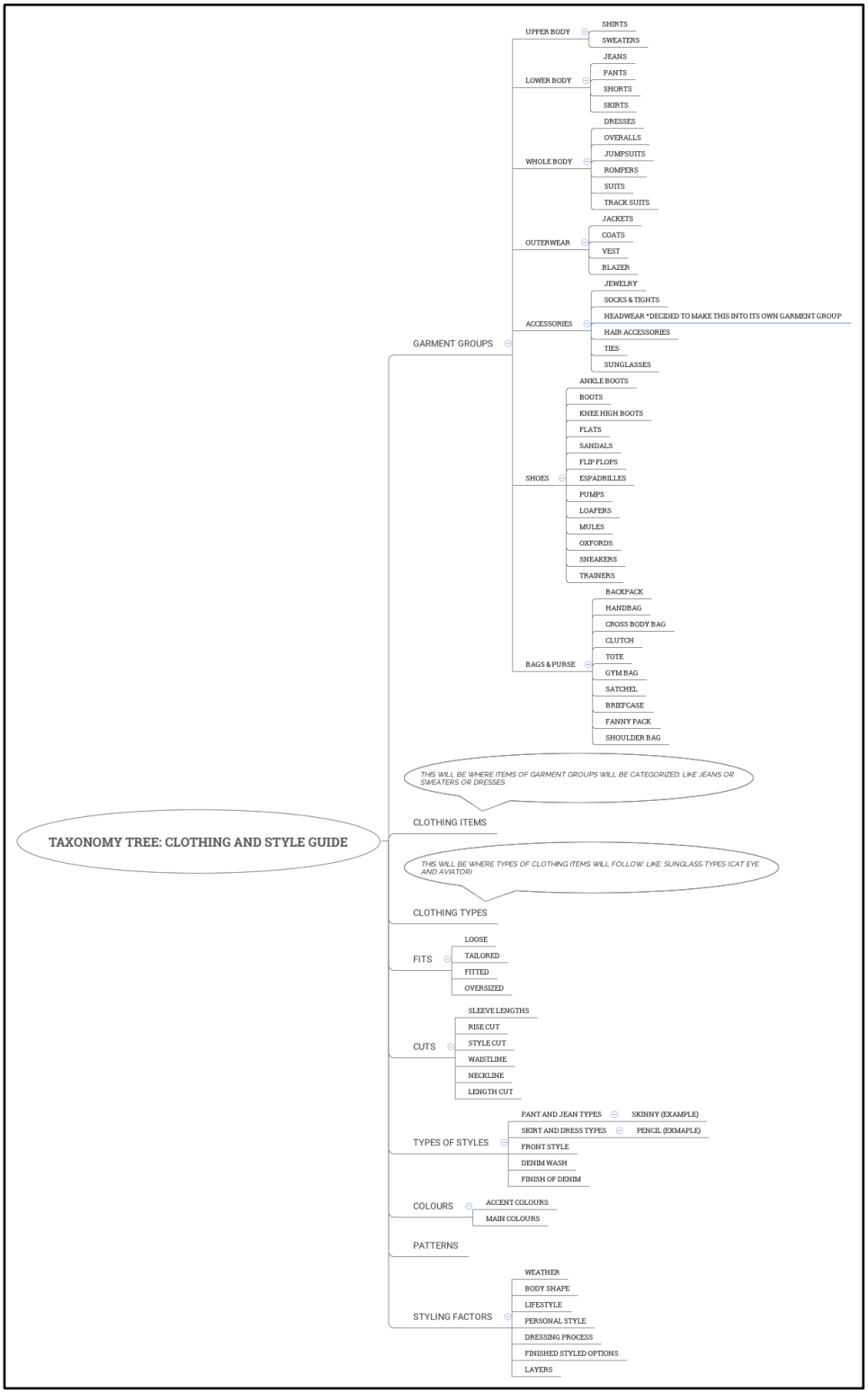

Figure 4: Taxonomy Tree

I took the categories from the taxonomy tree and built a folder hierarchy system to test my train of thought: *these categories, subcategories and attributes can be used to build a data-driven technology (database) and in the end recommend a complete outfit, based on personal factors such as body shape and weather*. I designed the folder hierarchy system similar to a labelling system, where you click each folder (category) to get to the final item of clothing, using the categories, subcategories, and attribute classifiers. To test this theory, I would take a screen shot of a clothing item from an online retail store and note the descriptions the website gave the item and see if I could place it into a folder in the hierarchy system I designed. I would start at the front of the folder hierarchy system which was 'garment groups' and keep following the suitable attributes to place the image in the proper end file. *Figure 5* shows this process and my turn out of the apparel classifier dataset, designed from the taxonomy tree. This thought process worked, so I was able to move into building out the recommendation database. Which is taking the same categories, subcategories, and attributes.

Figure 5: Apparel Classification Folder Hierarchy

I originally wanted to design my own apparel classifier system that would be able to classify all attributes on clothing items. This includes attributes like waistlines, necklines, or pant and jean styles. There are no apparel classifier databases I could find through my research that can identify these attributes, or are designed how I have built this one. I am using the Clarifai AI, which is a pre-trained AI model, that can detect specific attributes from an image. For the

attributes it cannot detect, such as neckline or pant and jean styles, I will have the user start to build the apparel classifier system by identifying attributes the API cannot detect by making their selection through a scroll list on the front end. This will assist in building and improving the machine learning side of an apparel classifier system.

This process took a long time to sort out because I originally had a lot of subcategories in categories like sleeve lengths and then removed them, but then thought I should add them back in. When I started to upload images into the folders, looking at the descriptions made me overthink how I wanted to classify descriptions of clothing and accessories. I went through a few iterations of this until and decided to think in basic terms when describing clothing and accessories. I continued uploading images into this folder hierarchy, where I was able to start building the recommendation system. It also identified the categories going into the recommendation system, and what attributes will be taken from the Clarifai API.

I took the categories and subcategories from the folder hierarchy system and designed a normalization database. This is where using an interdisciplinary design team and I started to work together, because I had control on the subject matter I am the expert in, but had experts consult me on the technical side of what I wanted to create. The folder hierarchy was straightforward, this took more research and consultation meetings before I moved forward. The recommendation system takes the categories and subcategories I had configured and builds relationships between them based on the important factors I identified as being key pieces to think about when getting dressed like: body shape, lifestyle, and weather. This was a more fluent process because I had identified how I wanted the relationships to run and communicate between one another, to recommend the perfect outfit for the user. It was important for me to identify what would be considered a category, sub-category, attribute, and a variable from the

information placed in the taxonomy tree, because it identified the categories needed and the relationships between everything needed to run a recommendation system. *Figure 6* shows the system design of the apparel classifier system.

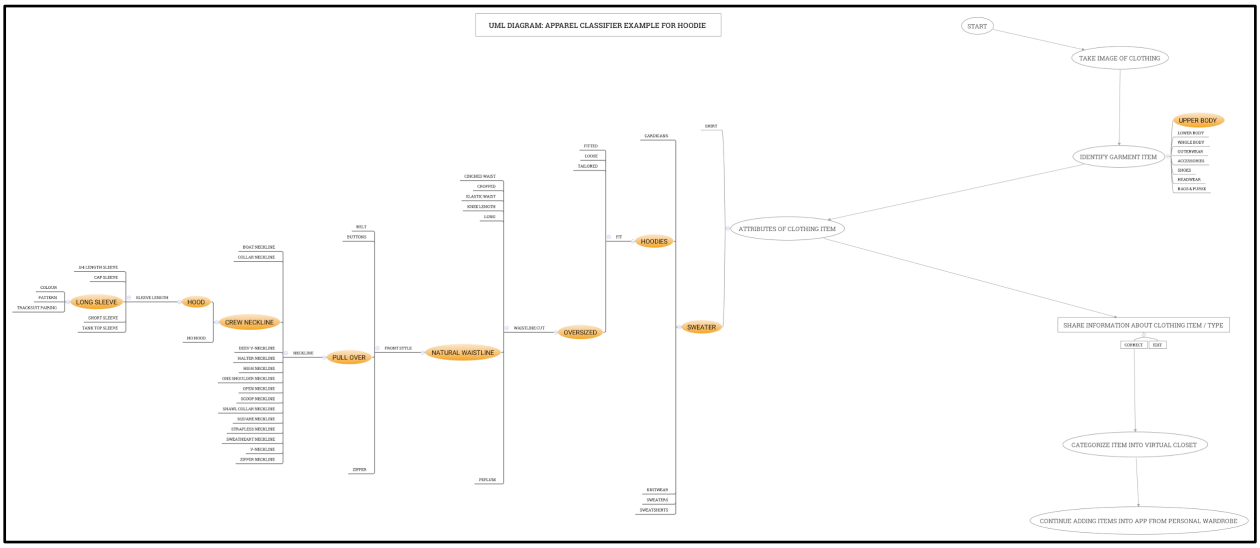

Figure 6: Apparel Classifier System. Example of a Lower Body Clothing Item.

THE GOAL OF THIS IT TO BUILD AN AI API THAT WILL BE ABLE TO READ ALL OF THESE FEATURES. THIS IS THE STARTING POINT TO GROWING THIS AI - USING THE USER INPUT AS A PROTOTYPE / NOT THE FINAL FOR WHEN IT WILL BE AVAILBLE FOR DOWNLOAD.	ALL OF THESE ITEMS HAVE AN ID NUMBER ASSOCIATED TO THEM IN THE RECOMMENDATION SYSTEM.			
UPPER BODY:	SCROLL LIST OPTIONS / LABELS	AI API	USER	NOTE
ITEM:	SHIRT / BLOUSE / GRAPHIC BASIC / BODY SUIT / CARDIGAN / SWEATER / HOODIE / KNITWEAR / SWEATSHIRT	✓	✓	THE USER CAN EDIT THE ITEM OF CLOTHING IF THE API AI DOES NOT LABEL THE ITEM CORRECTLY. THESE ARE THE OPTIONS IN THE RECOMMENDATION SYSTEM FOR UPPER BODY CLOTHING TYPES.
FIT:	LOOSE / FITTED / OVERSIZED / TAILORED		✓	THE USER WILL SELECT FROM A SCROLL LIST OPTION WHICH KIND OF FIT THE ITEM OF CLOTHING THEY ARE UPLOADING IS.
COLOUR:	BEIGE / BLACK / BLUE / BROWN / CORAL / DARK GREEN / DARK PURPLE / DARK RED / GOLD / GOLDEN / GREEN / GREY / LIGHT BLUE / LIGHT GREY / LIGHT PINK / LIGHT RED / LIME GREEN / MULTI-COLOUR / NAVY BLUE / OLIVE GREEN / ORANGE / PALE BLUE / PALE RED / PINK / PURPLE / RED / ROYAL BLUE / SILVER / SOFT PINK / TEAL / VIOLET / WHITE / YELLOW	✓	✓	THE USER CAN EDIT THE COLOUR OF GARMENT IF THE API AI DOES NOT LABEL IT CORRECTLY OR CANNOT LABEL IT AT ALL. THROUGH A SCROLL LIST.
PATTERN:	CHECKERED / FLORAL / LACE / LEOPARD / PINSTRIPE / POLKA DOT / STRIPED / TARTAN / TIE DYE / TORTOISE / ZEBRA / GLITTER / SNAKE	IT CAN CLASSIFY THAT THERE IS A PATTERN.	✓	THE USER WILL SELECT FROM A SCROLL LIST OPTION WHICH KIND OF PATTERN THE ITEM OF CLOTHING THEY ARE UPLOADING IS.
WAISTLINE:	CROPPED / KNEE LENGTH / LONG / PEPLUM / NATURAL WAIST		✓	THE USER WILL SELECT FROM A SCROLL LIST OPTION WHICH KIND OF WAISTLINE THE ITEM OF CLOTHING THEY ARE UPLOADING IS.
SLEEVE LENGTH:	3/4 LENGTH SLEEVE / CAP SLEEVE / LONG SLEEVE / SHORT SLEEVE / TANK TOP SLEEVE	IT CAN CLASSIFY THAT THERE IS A SLEEVE.	✓	THE USER WILL SELECT FROM A SCROLL LIST OPTION WHICH KIND OF SLEEVE THE ITEM OF CLOTHING THEY ARE UPLOADING IS.
NECKLINE:	BOAT / COLLAR / CREW / DEEP V / HALTER / HIGH / ONE SHOULDER / OPEN / SCOOP / SQUARE / STRAPLESS / SWEATHEART / V-NECKLINE		✓	THE USER WILL SELECT FROM A SCROLL LIST OPTION WHICH KIND OF NECKLINE THE ITEM OF CLOTHING THEY ARE UPLOADING IS.
FRONT STYLE: (THIS LINKS TO ALL SWEATERS)	BELT / TIE / BUTTONS / OPEN / PULL OVER / ZIPPER	IT CAN SOMETIMES CLASSIFY THAT THERE IS A ZIPPER OR PULL OVER ITEM	✓	THE USER WILL SELECT FROM A SCROLL LIST OPTION WHICH KIND OF FRONT STYLE (HOW THE SWEATER IS PUT ON) THE ITEM OF CLOTHING THEY ARE UPLOADING IS.
SUIT PAIRING:	YES / NO		✓	THE USER WILL SELECT FROM A SCROLL LIST IF THE ITEM IS APART OF A SUIT
TRACKSUIT PAIRING:	YES / NO		✓	THE USER WILL SELECT FROM A SCROLL LIST IF THE ITEM IS APART OF A TRACKSUIT

Figure 7: AI versus User Interaction, for Upper Body

The front-end system was built in tangent with the back-end planning. When I started this journey, I started with the front-end design to start the process in understanding the mind maps

and taxonomy tree, however it was put on hold for a bit so I could focus on the back-end. I needed to understand the relationships and logics between categories so the front-end system will pull the right data from the questions being asked and answered. Going through the logic of the recommendation system finalized the front-end new user steps and layout of the existing user wardrobe.

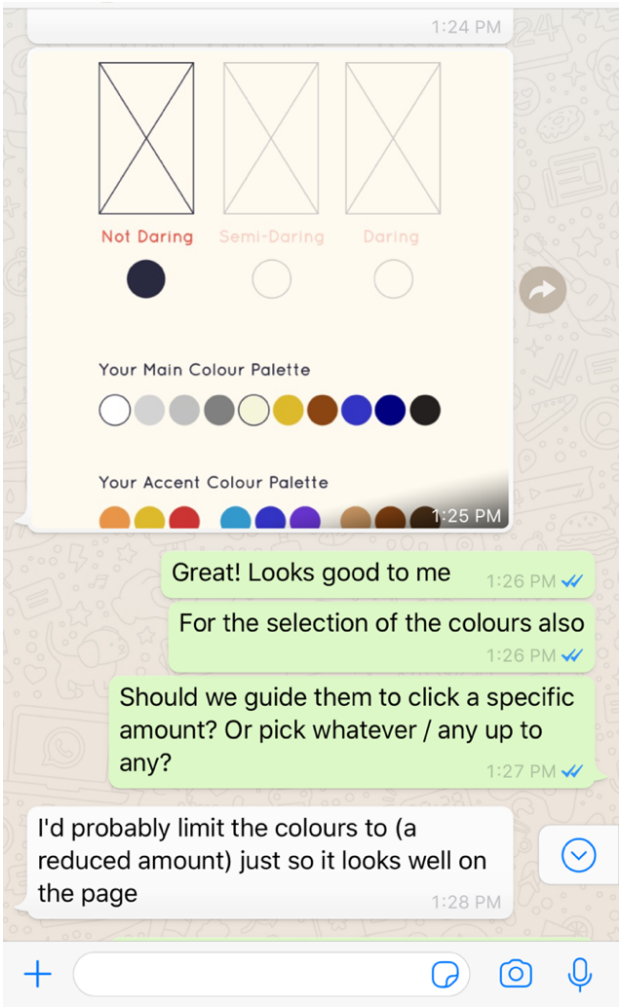

Figure 8: UI Design Process

(4.3) Components

(4.3.1) Apparel Classifier System

An apparel classification system's core tasks are to detect clothing types, their attributes, and categorize it with similar apparel. This type of task is a part of machine learning, otherwise known as deep learning. "Neural networks, developed in the 1950s not long after the dawn of AI research, looked promising because they attempted to simulate the way the brain worked, though in greatly simplified form" (Hof, n.d., para. 10). For this specific classification system, we are using Clarifai because the pre-trained neural network I want to work does not exist. To start the build of this we are using a pre-trained AI model to build the growth of the neural network Classification as a neural network. "…neural network model to classify images of clothing, like sneakers and shirts" (TensorFlow, n.d., para. 1). The database I built and configured is to train the models on how to think and identify apparel based on the clothing type and its attributes. This AI model will not be able to identify all the attributes I need it to, so for the items it cannot identify the user will answer the question with a scroll list of options, to assist in training the AI apparel classifier model. The Clarifai API we are using for the apparel classifier system will connect with the API system we have built for the recommendation system.

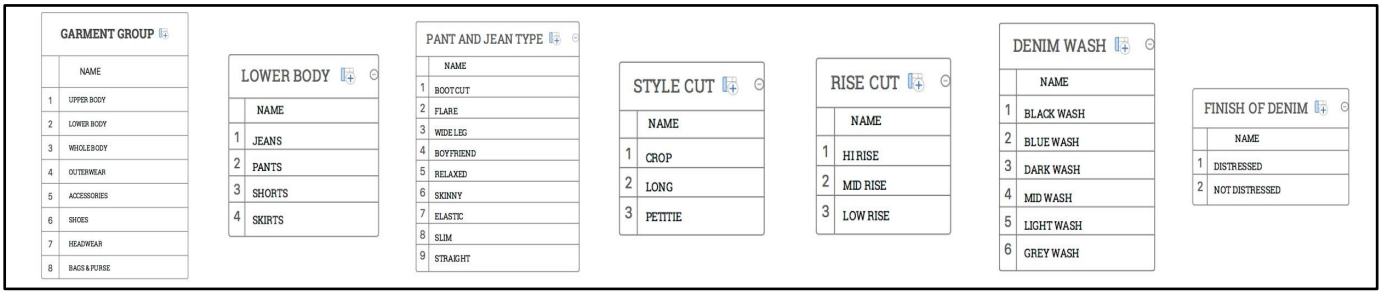

Figure 9: Apparel Classifier Neural Network Model. Example Lower Body.

(4.3.2) Recommendation System

The recommendation system designed for this mobile application is to recommend outfits from the clothing uploaded in the user's wardrobe. It is not a personal shopping recommendation system, where it searches for clothing items on the web to recommend to you. The recommendation system looks at the classifier attributes of the images and finds the matching relationships of those fits, cuts and styles. I am assigning names of fits, cuts and styles, as an example, to numerical values or true and false tags to train the machine to recognize patterns and rules through arrays. To build this process, I am using a database normalization method. This method allows me to define relationships between different tables, and organize all of the data going into the database. "Normalization is a process or set of guidelines used to optimally design a database to reduce redundant data" (Plew & Stephens, 2003, para. 5). The goal of this process is to eliminate any redundant characteristics, so there is an overall organization and it is easy to modify as time goes on. For this specific system to run well and make sure the relationships work will be to set types of queries. This will involve identifying action and parameters around the categorize that will link together, as there is some redundant characteristics between the lower body and whole body garment group tables, like the pant and jean type attribute tables.

The entire recommendation system for this thesis was designed in Excel with multiple sheets. I used Excel because I could create my own prototyped neural network between each of the sheets to show how they connect and work together. I did this so I could see the relationships between different attributes and for my developers to see the connections. The final database that the developers coded is turned into an API, which will be working with attributes pulled from the

Clarifai API for the apparel classifier system, and the API we have implemented that focuses on colour theory when matching colours together.

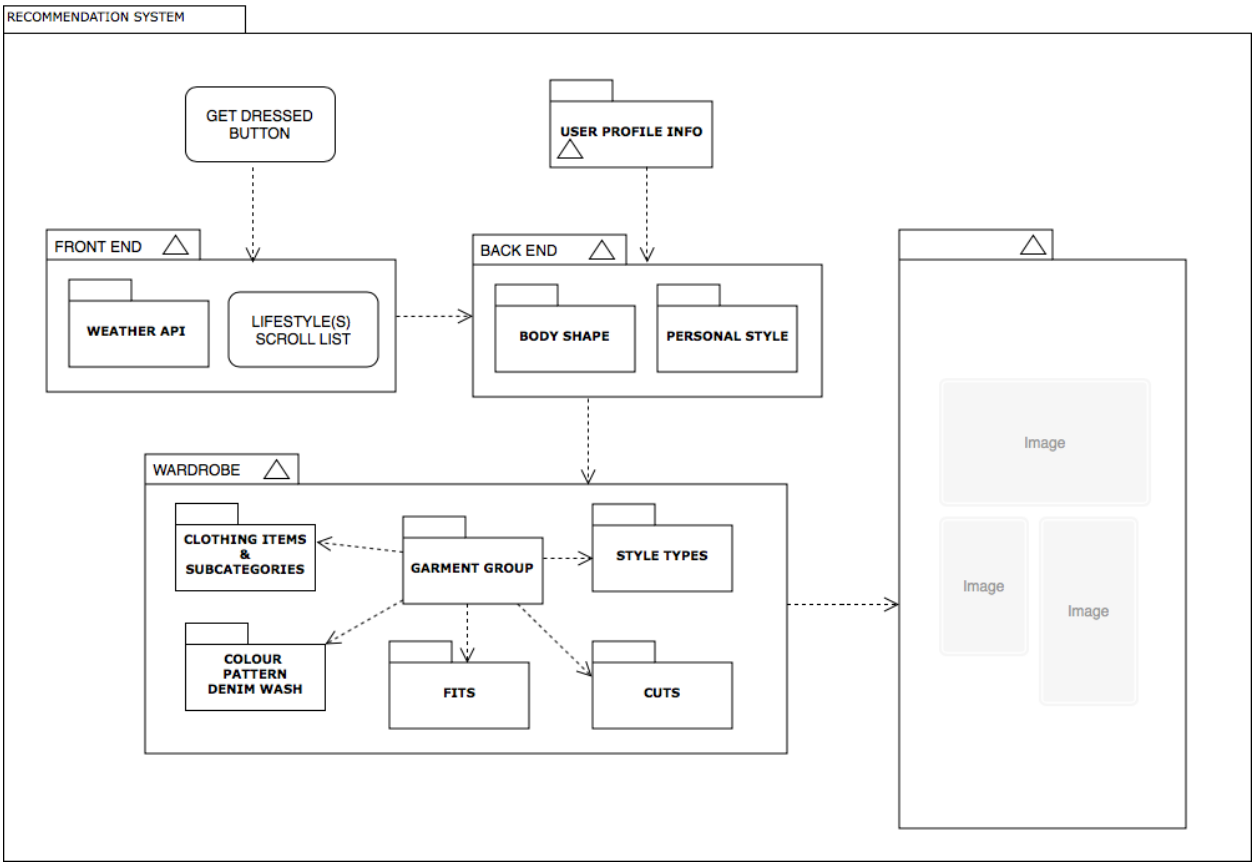

Figure 10: UML for Recommendation System

(4.3.3) UX/UI Design

The purpose of the mobile application is to *recommend the right outfit that makes you feel good, from your personal wardrobe*. The ethos or otherwise known as the character is aimed to *style outfits that suit your personal lifestyle, body shape, and styling preferences*. Shaping the product with the system and perceptual design plays as important role on the psychology side from the experience the user has with the mobile application.

Design Systems by Alla Kholmatova gives strong insight on how to design something that has a clear message. I am putting a lot of work in building the 'behind the scene' functions of the recommendation system, that I need the mobile application to have a clear message. "A design system is a set of interconnected patterns and shared practices coherently organized to achieve the purpose of the digital product." (Kholmatova, 2017, p.18). Deep diving into the principles and patterns of a strong mobile application allowed the production of my practice to understand of the focus of the mobile application, so the front-end and back-end is cohesive.

I am working with a freelance UX/UI designer Hammadullah Syed, from the Digital Futures 2018 graduates, who follows identical functional and perceptual patterns as this book highlights and mentions. The reason I worked with a freelance design artist is because the front-end is not a strong suit of mine. "A design approach is mirrored in the front-end architecture; design patterns follow the guiding principles; the pattern language is applied consistently in design, code, and the pattern library." (Kholmatova, 2017, p.39). This book focused on answering one of my secondary research questions which asks what is the best way to display the information needed for the functional system to work.

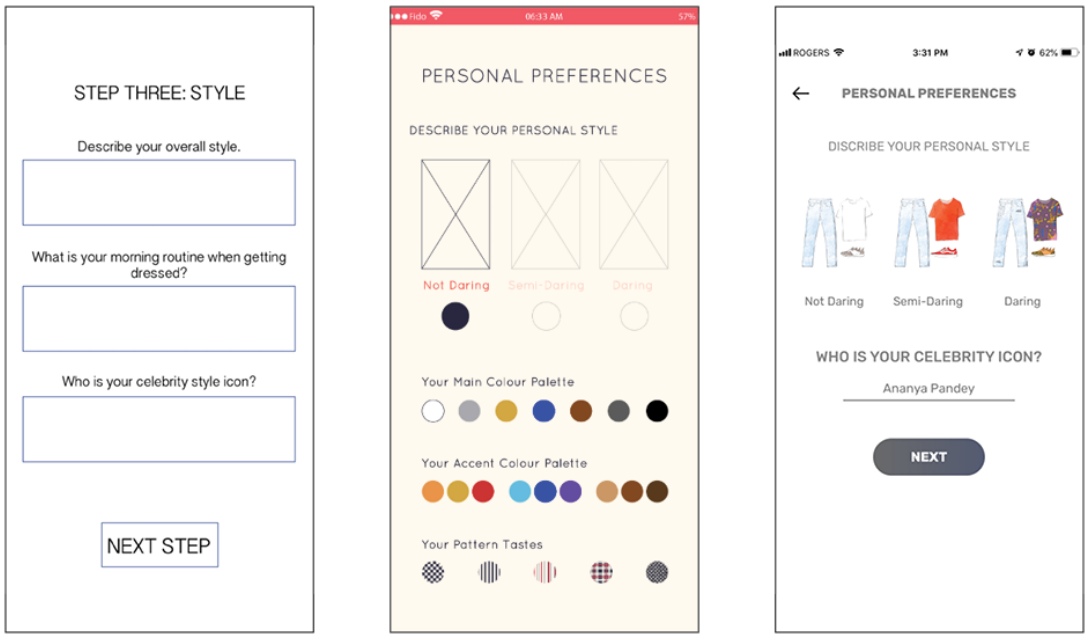

Figure 11: App Page Iterations (personal preferences page)

(4.3.4) Reflections

This information is a new subject matter for myself to understand, and thanks to my expert consultation method I was able to turn my mind maps into a database. When reading about these different technological tools and methods I can understand what they are talking about, so when I am working with my developers we can speak the same language easily about the goal of the application.

Building out this database, which is available to view by clicking the link provided with "Appendix B", had less iterations than I originally expected. Through the process of writing my folder hierarchy system and cutting down on the number of attributes that could be used to describe an item of clothing is what made it the link between the apparel classifier system and recommendation system an easier relationship. The iterations on this database were focused on

how I defined Clothing Items and Types. Originally, I built and connected sheets for *Clothing Items* and *Clothing Types*. I did this because some clothing items like shirts, have different types. This created more IDs for the neural network and more questions about the attributes of clothing items for the user and apparel classifier API to answer. We condensed these sheets to have the apparel classifier system to the recommendation system smooth. We did this by making a Clothing Item sheet and a Subcategory sheet of those clothing items. *Figure 12* gives an example to this. This has made both the function of the database and machine learning more connected.

id	name	garment_group_id	has_sub_type
1	BELTS	1	0
2	SUSPENDERS	1	0
3	HAIR ACCESSORIES	1	1
8	ANKLETS	1	0
9	BRACELETS	1	0
10	EARRINGS	1	1
11	NECKLACE	1	0
12	RINGS	1	0
13	POCKET SQUARE	1	0
14	NECKTIE	1	0
15	SOCKS	1	0
16	TIGHTS	1	0
17	SUNGLASSES	1	1
20	SCARVES	1	0
21	WATCH	1	0
64	BAGS	2	1
67	JACKET	8	1
33	SHIRTS	6	1
34	SWEATERS	6	1
61	BLAZER	8	1
62	COAT	8	1
63	VEST	8	1
22	SHORTS	5	0
68	PANTS	5	1
23	SKIRTS	5	0
24	DRESSES	7	0
25	JUMPSUITS	7	0
26	OVERALLS	7	0
27	ROMPERS	7	0
65	HATS	3	1

Figure 12: Clothing Items & Subcategory Database Sheet

When it comes to the data of this product it was important to the practice of this product to keep it simple to identify and for the user to understand. When labelling the categories, sub-categories, and attributes I did it to the user can learn about the fits, cuts, and styles they own and

further, what they like to wear. This in the future will assist with people being able to converse with sales associates when shopping for new clothing items because they will know what they feel comfortable in.

(4.4) Final Version

(4.4.1) Description

This thesis practice was an iterative process with my interdisciplinary design team. This iterative process started with taking the database I built on Excel, and going through two iterative stages to the final database for the apparel classifier system and recommendation system. The pace of the practice that went into this thesis project started with the planning stages, to wireframing, and then developing. Each stage was completed and went through a process of expert consultation before moving onto the next step of development. Through this iterative process, I came to the final product of my intention. The final version of the *What Do I Wear?* prototyped mobile application was developed for an iOS application under the guidance of my developers.

The technologies that were used to build the iOS development include:

1. Programming Language: Swift 4.2
2. Programming Tool: Xcode

The technologies that were used to build the backend development include:

1. Programming Language: PHP

2. Programming Framework: Laravel 5.6
3. Database: MySQL

(4.4.2) Process

The final version presented is a proof of concept database, presented in a prototyped mobile application. Through the process of my research and practice it was apparent that since I am building an AI system, using machine learning, that has not been done before, I needed to prove that I could build a database that thinks how professional personal stylist do. This is why I have focused less on the user experience of the mobile application, and put majority of the research and building on the back-end system and user-interface of how to run the database. This was completed with my interdisciplinary design team.

When it comes to styling an outfit there are endless possibilities. To build the recommendation database, it was important to keep the scope of what styling an outfit meant for the intended goal of this thesis project. A key goal when building the system was to give the user a complete outfit from top to bottom, using the selected garment groups: lower body, upper body or whole body, styled with outerwear, shoes, accessories, headwear, and bags. Due to scope of this database it was necessary to keep everything simple, because it was also difficult to inform the API's that based on nuances in weather for example if you can layer your t-shirt with a cardigan sweater. For the final suggestions of a complete outfit the system will only focus on suggesting one item from each of the garment groups based on the users' lifestyle activity (*professional, casual, formal, active)* and the weather.

The output of the apparel classifier system will run with multiple API's. There will be API's that will retrieve the preferences the user selects on the front-end of the mobile application. This includes the pages '*My Shape'*, '*My Style*' and '*My Wardrobe*'. Another API will provide information that the user needs to respond to during the wardrobe upload process such as the attributes of clothing items. For the purpose of this paper API means the connection between the front-end of the mobile application and the back-end of the mobile application; there is no third-party API.

The output of the recommendation system will connect with the received preferences from the user and the multiple API's in the apparel classifier system, and through that connection will recommend a single item from each garment group, that curates a complete outfit.

Through expert consultation I was advised to showcase what is important, and build from that. I sketched, with my UI designer a system that asks the front-end questions needed to run the back-end system to recommend the ideal outfit for the user. This allowed me to focus on building my focus and goal, being the back-end system of the apparel classifier and recommendation system.

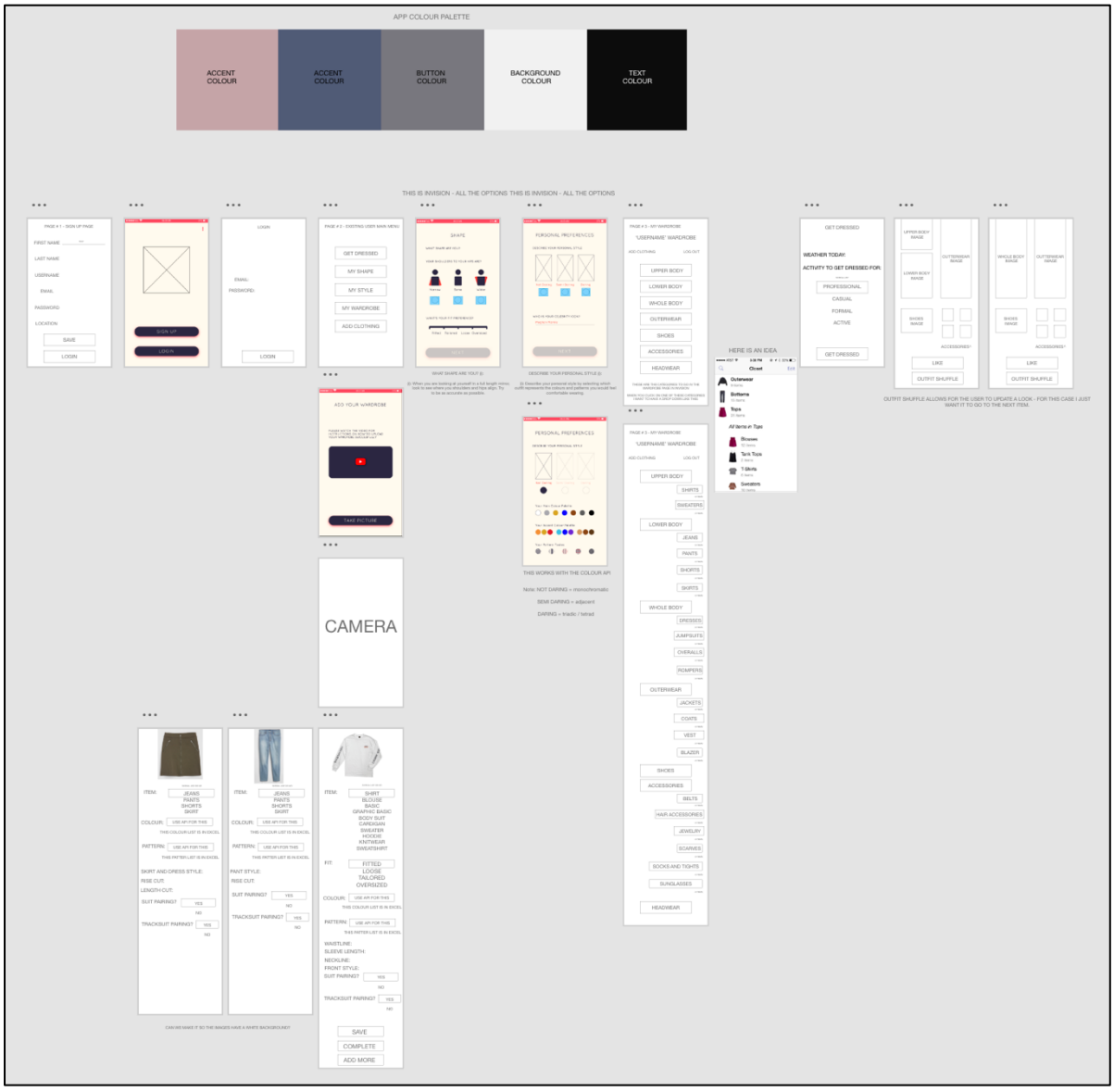

Figure 13: Wireframe Sketch

(4.4.3) Expert Consultations

By using the method of expert consultations, I was assisted in being able to develop an application that works. This method was completed through timely conversations on Skype and WhatsApp.

Freelancer Hammadullah Syed and I worked together once the databases were almost completed. We talked about the back-end system and how I need it to run, and how to link it to the front-end design. The development team from Foremost Digital and I worked together once the databases and UI were completed. We worked together on understanding the capabilities of how this system can run, since nothing similar has been designed.

(4.4.4) What's Next

The development and technological advancements in artificial intelligent technology is only growing and improving. The future research and practice in this thesis project to continue on iterating the AI databases, and improve the personality insight. Along, with bringing the mobile application to market. Specifically, with the recommendation system and apparel classifier database, the goal to developing this artificial intelligence is to partner fashion brands and link our database to have access to their online inventory, so the system can learn and adapt to the fashion languages used to describe the variables in clothing. This will allow our database to keep up to trends and what is current in the industry when it comes to fit, cut, and styles in the industry.

Chapter 5: Conclusion

(5.1) Concluding Statements

Through the exploration in my research, practice, and methodological framework I have taken my critical thinking in personal styling and translated this process into an algorithm. Working with the developers, I have delivered a prototyped mobile application that demonstrates a way of data-driven technologies can assist people with the task of getting dressed, using their pre-existing personal wardrobe.

The 'simplicity of getting dressed' is in itself incredibly complex. The focus of my thesis project was to build a recommendation database that takes the information from the following steps on the front-end of the mobile application: *wardrobe upload, defining shape, styling preferences, and the users' location* and be able to curate and generate a complete outfit; that the user feels confident in.

It was during my building stages that I started to realize the capabilities the mobile application can have in the technology business world, fashion industry, and to the users that will download the mobile application. This mobile application is tailored towards the primary target group of people who are looking for assistance when getting dressed because they feel unsure of what is considered a coherent outfit for personal factors such as, body shape, personal style, and lifestyle.

Four billion pounds of the clothing we return online goes to a landfill every year[3]. When we shop online we tend to over purchase because we are not sure what fits or will look good on us. This uncertainty has caused the retail technology sector to look for new ways to make online shopping more personalized. New technologies like artificial intelligence, virtual reality, and the internet of things are being introduced to revolutionize retail and give customers a more personal experience.

The fashion industry is merging with the technology industry in many ways. It has been said, technology is shaping the fashion industry, and "technological advances are being pushed to the limit" (Pfaff, 2018, para. 2). Since the introduction of online shopping, fashion companies are looking for new ways to grow their sales by giving their consumers a more enjoyable experience and a connection with their brands in a more personal way. Majority of us prefer to shop online because of the convenience it brings to our busy schedules.

Across the US by December more than 6,985 brick and mortar stores closed. Technology companies and the innovations are looking to help brands boost their businesses both online and offline (Chitrakorn, 2018, para 1). The future of fashion is working with technology companies to fix the issues brands, manufacturers, wholesalers, and retailers have with their customers.

(5.2) Business Plan

I have incorporated a business plan, "Appendix A", into my thesis because I am working to make this application available to the mass market, and build a fashion technology company

[3] Mehta, A. (2018, July). *Where do your online returns go?* Retrieved from https://www.ted.com/talks/aparna_mehta_where_do_your_online_returns_go

around this application. This business plan highlights the monetization and *what's next* of this application. This business plan has been advised with my company's business team: Business Financial Advisor Kelby Price, Vice President of Corporate Development at Labrador Technology, Inc and Business Manager Patricia Shinkaruk.

As a start-up company we developed this business plan to focus on the monetization goals we see for this mobile application. We have drafted this business plan for our future investors and partners to hear about the nature of our business, our strategies and objectives both as a company and a product. Through the development of this business plan I have taken note of the competitive advantage we have in both the mobile application market, and as a fashion focused mobile application.

A key message we want to guide this business plan is that, four billion pounds of clothing, returned from online stores, is going to our landfills every year. This was important for us in the development of our key insights, because it shows there is a benefit in the monetization goals we have for this specific mobile application product; but also, for other devices we plan to incorporate as we grow.

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Appendices:

Appendix A: Business Plan

WHAT DO I WEAR?

Action Plan

Description of the Business

What Do I Wear? is a start-up company being organized to develop a software application for mobile devices such as smartphone and tablets. We have designed an app that will engage with all end users to assist them in getting dressed and building a wardrobe they feel comfortable wearing. We are adapting the critical thinking personal stylist and shoppers do when working with clients, and have developed a process that is available to the mass public. We have submitted a utility patent that is pending to grow the digital distribution outlet to brick and mortar retail locations. We are a unique product in the field of technology and fashion because of the utility our app offers to both our current and future business partners and our end users.

Major demographic, economic, social and cultural Factors

We have tailored this app to be used and targeted towards anyone looking for assistance when it comes to getting dressed or shopping for clothing. This in short, targets young professionals who want the benefits of being styled but do not have the time to spend getting dressed in a coherent and suitable outfit. The unique factor of our application is we have no gender bias in the

questions we ask or the language used. We have broken down our demographic / users into two categories of target markets.

Our primary target market: People who are looking for assistance when getting dressed because they feel unsure of what is considered a coherent outfit for personal factors such as, body shape, personal style, and lifestyle.

The secondary is our expansion target market: People who want to save time on their process of getting dressed, and use this app as an opportunity to source new outfit inspirations.

This app allows each user that downloads it so choose the economic, social, and cultural factors they have when shopping or dressing. We have designed the app to have it learn about the user by gaining personality insight to each person it is assisting in recommending outfits or shopping for.

Value Proposition

The intellectual property the founder brings to the company is significant. With her past career as a personal styling and shopper, she is able to bring forth a methodology of critical thinking for fashion that connects seamlessly to technological language. Her experience is vital because her understands the in-person process that consumers go through when selecting outfits.

This understanding is what will make getting dressed an easier process for the fashionable user and non-fashion forward person is the reason we as a company are able to present the current iteration of the future developed product. Her networking rolodex fuller with contacts and knowledge of different fashion brands through her past career has given the company the ability

to connect and partner with retail fashion brands that are keen to forge a partnership of the idea presented because they recognize the value.

The company's value proposition is applying machine learning into the space and improving on the technology that currently exists in fashion. This will be completed by proving that machine learning is flexible and viable for human tasks; being personal styling and shopping. What makes us unique about this product is, it is tailored to the user to solve the complex relationship we have with getting dressed, through machine learning and the users' interaction with the app.

Key Partnerships

Our business plan includes strategically partnering with companies with similar philosophies, core beliefs, capital to enable growth and experience that we can benefit and learn from as we focus on growing the company as a whole but also companies that will give us autonomy to develop.

We will be focused on targeting fashion brands we believe will symbiotically benefit the application stability and growth. We have already started this connection and conversation with two internationally respected and recognized known clothing brands, and will continue to network to widen the scope of our partner brands. These partnerships are key for the company because it is one step through stabilization of the company through monetization. Through the data analytics we provide each brand, and allowing our users to purchase clothing from their online stores we are looking to make this connection a partnership in growing this application.

The marketing strategy partnerships we will be signing are with fashion influencers on social media, to develop and deploy our SMM strategy. The company intends for its app to become a

leading mobile app at a global level and will accomplish this with a strong social media marketing (SMM) campaign and proven online advertising methods that will be explained in the marketing strategies.

Strategic Alliance

The local development community, specifically in fashion technology, will be a strong resource network. Peers are not only mobile app developers; they also include marketers, Web designers, hardware specialists, digital content creators, third-party vendors, and more. The company will take pride on keeping a valuable, digital "rolodex" (basically, key social media contacts). For example, after our app is completed, the company will want to reach out to reviewers, tech and fashion journalists, fashion influencers, and local news media.

Another component of our strategic alliances will be to work with sales associates and personal stylists in fashion to build their understanding of fits, cuts, and styles that each of their customers will feel comfortable in. This app and company has a goal to not take over important jobs in the fashion industry, but to further the conversation around conscious shopping.

Ethics

With the advancements being used to act as a personal stylist and personal shopper, any user will never feel that they have to sacrifice anything from their personal style to the price of their clothing. Our concept is to lead with the information the user has in their profile and virtual wardrobe to understand what they like. The motivation behind this is

to strengthen the conscious consumer market, for both all fashion brands. Through my own experiences and working experiences I have thought about the ethical implications this mobile application can have on both the market and consumers using the product. This is to build trust. Trust in a similar way to when we style outfits together, that we feel comfortable in we start to understand our fit preferences and style preferences. This app will assist in this process to understand fit, cuts, and styles each user likes on their personal body shape to build their confidence in styling outfits to get dressed and one day become a user in the app to source new outfit inspiration.

Trends in the Industry

The top advancements that are being introduced into fashion are, Internet of Things (IoT), artificial intelligence (AI), mobile commerce and virtual and augmented reality. These new digitized advancements are wanting to revolutionize how businesses operate and improve on customer experience. Kim Kardashian created an application called Screenshop, that allows you to screenshot a look you like and find similar products at any price. This application uses AI pull information from a photo, like colour, fabric and cut to name a few, and work as a personal shopper to assist in finding looks for you.

The largest tool companies are introducing to monetize their brand is IoT. IoT is like wearable technology. Nike created a shoe that allows you to track your running performance on your smartphones. “Visa will be using IBM’s Watson IoT platform to allow developers add mobile payment technology to devices and also talked up the prospect of a pair of shoes embedded with a chip that alerts runner’s fitness tracker letting them know how many miles they’ve logged and when it’s time to buy a replacement pair” (Sawh, 2017, para. 4). The benefit from a business

perspective is for companies to understand their consumers needs and wants, which in turn improves customer experience.

AI is the other tool that is creating a buzz in this and many other industries. Companies are using AI to gather data, analyze and sort through it to better understand and predict what customers are looking for when they shop. Lastly, virtual and augmented reality. This type of technology is introducing a new wave to the concept of shopping. These platforms are bridging how we shop in physical locations and online. With online shopping hurting our planet with the amount of clothing going to the landfill per year, this technology is looking to assist in having customers purchase items that are equivalent to their expectations.

Objectives

Short Term:

- Raise Capital: Looking to connect with investors to raise capital so this start-up company can continue its development and research. We will use this capital to hire technologist, designers, product and marketing teams, and fashion experts.

- Develop App: We have the proof-of-concept prototyped mobile application created. It is to build on this current version to the version wanted for launch.

- Launch App: After a year of developing we will launch the app to the market place using our marketing strategies and key partners.

- Build retail and data analytics for fashion brands: Through our data testing, and first few months of downloads from the public, we will pitch these data analytics to other fashion brands we have not partnered with.

- Launch company website: During our process of raising capital, we will have a company website launched to start networking with potential key partners and identify our marketing strategies.

- Start marketing campaign: We will start to connect and built with potential influencers and other SMM partners a few months into our development.

Long Term:

- Forge alliances and affiliations: For this company to be reputable it will be because we have networked and connected with other companies that will assist in us building a technological company. We will continue to develop, update, and integrate ways to forge alliances and affiliations on how to market, advertise, and develop our app and other company devices.

- Create a solid profitable company: Revenue generated from the app market is expected to continue to grow over the next several years. A report by App Annie states that "in 2016, the global mobile app market is projected to expand 24 percent to reach $51 billion in gross revenue (the amount consumers spend on

mobile apps via stores) across all app stores. By 2020, gross revenue across all app stores will exceed $101 billion, globally."

Versions

First version features:

- New User sign up / registration
- Existing User login, profile, and wardrobe functions
- User wardrobe upload and classifier
- Outfit recommendation
- Weather API

Second version added features:

- 3D body profiles
- Wardrobe Statistics
- Brand Analytics
- Personality Insight
- Personal Shopping functions and advancements
- Retail Brand partnerships to have them upload their inventory into the application

- Business marketing advancements
- Improvement suggestions: *to be added after development of the application*

Third version added features:

- 3D body profiles, with AR features
- Maternity database
- Utility patent to be linked to the *What Do I Wear?* mobile application
- Personal shopping advancements
- Consignment / clothing selling features
- Business marketing advancements
- Link with other apps: (EX) fitness applications and outfits to wear to that class
- Improvement suggestions: *to be added after development of the application*

Executive Summary

Objectives / Description of the Project

The mobile app market is vast and very active, and it shows no indications of slowing down in terms of growth. By 2017, its expected that over 268 billion downloads will generate $77 billion worth of revenue. The company intends to carve into. This market and in doing so yield revenue and profits as detailed in this business plan by monetizing this app. The company will engage in

mobile function development, which is the process of developing solutions for the growing market of advanced devices.

The application developed will enable mobile device owners to have their own personal stylist and personal shopper at their fingertips through the steps of:

Build a profile:

The application gathers data on personal insight about each individual user. For instance, it will gather information on each users' preferences such as: personal style, clothing brand preference, body shape, and information on the fits and cuts of clothing they own and wear most often. This data will continually be gathered and placed into a style statistic page for the user to learn about what they wear the most, and why.

Upload wardrobe:

Through the process of taking images of personal clothing, accessories, headwear, and shoes in their current wardrobe the application will categorize each item into their virtual personal wardrobe. The user will work with the technology embedded in the back-end of the app to note of the attributes of all clothing items. We are in development of making this more of an automated process for the user, by building the artificial intelligence so the app will be able to identify all attributes of clothing items without the users' assistance.

Provide Outfit and Clothing Recommendation:

The process of getting dressed in a coherent outfit will be an easier task with the use of this app. The application will identify and take into consideration what your daily schedule is, the weather

of your location, what is clean, and what was last worn before it recommends a completely styled outfit. With providing the option to outfit shuffle items in the recommended outfit, till you like the outfit. Before you even have to try the outfit on, you can place it on your 3D body profile avatar and see if you like it with finishing styling tips.

Personal Shopping:

With your 3D body profile and data being gathered on your personal preferences of how you define your style and like your clothing to fit, the application will take this information and work to source clothing that works for you from online retail stores. With notifications activated to send you items that your wardrobe is missing, you can additionally view the item of clothing on your 3D body profile so you can make a decision that will not result in a return.

Security and Privacy

When it comes to the privacy and security of the users for this app we will identify that all personal information is local to their account. The information we will be pulling from their app on their device is from their styling statistics page to share with our retail brand partners. The data being gathered through this page is anonymous. We will not be able to identify or link what data came from which user.

The same way users share their email on retail websites to be sent emails about promotions or sales, will be the same use our company will use for our users email addresses.

Business History / Nature of Operations

We are a start-up company that is focused on becoming a large Fashion & Technological company. The building and creating of the *What Do I Wear?* mobile application is the initial technological product this company will introduce to the market place.

The nature of our operations is to continue to build and iterate before, on, and after the launch of the *What Do I Wear?* mobile app. The large goal of our business and day to day operations is to look at the sustainability in the fashion industry, with fashion brands and consumers point of view on the state of fashion.

By taking consumers back into their already curated wardrobes and assist them in understanding what fits, cuts, styles, and colours they feel comfortable wearing. In this long run this will have people understand what to purchase when they shop so they do not over purchase or return clothing, which is affecting our ecosystem.

Service & Product

The company has a mobile app and any goods and / or services that may be offered via the app as its product offering. *What Do I Wear?* will supply tech support services to end users who download the app. The back-office products consist of intellectual property creation and registration that the end users get to see in the form of the mobile app they can install to their devices.

We will continually be developing a cutting-edge app that will take full advantage of [all] mobile technology. Although the company will pay attention to the latest versions and upgrades of the major operating systems such as iOS, Android, Windows Phone, BlackBerry, etc., it will not ignore the up-and-coming minority segments such as the Firefox and Ubuntu mobile devices. At

the same time, it will pay attention to resilient platforms that are still around this means, if it sees that a certain Symbian smartphone is still being used in developing markets, it may create a version of the app for the purpose of generating income and becoming known to this segment of end users. As we want to offer this app to anyone looking for assistance in styling outfits and shopping for items that suit them.

The company has outlined the following three main strategic goals:

- Develop a high-quality app that is functional, entertaining, and educational

- Keep abreast of new development in the market.

- Keep abreast of new developments with regard to app distribution channels.

The app will be produced in accordance to planning. The development team will meet frequently to discuss market opportunities. *What Do I Wear?* believes successful apps are not generally created by accident; to this end, it intends to work hard to come up with development concepts that will keep end users happy, and have them continually using the application.

Project Financing

To date the *What Do I Wear?* app has been personally funded. We have outsourced and hired a developing team and a user interface designer. This has cost a total of $6,700.00 to develop our first version.

Financial Institution

The financial institution of the company will be decided once investors show interest in the app. We are currently set to have meetings with potential investors. Kelby Price is the advisor when it comes to financing the *What Do I Wear?* app. The company may or may not require a financial institution, as investors might be all we require to complete the app for launch.

The Market

Market Segment

The company is entering a market that has exploded along with the proliferation of smartphones. The main fuel for this growth was from the Apple iPhone introduction in 2007. The iPhone led to numerous companies creating apps to work with the phone. Shortly thereafter Google ramped up the introduction of its mobile operating system call Android. The millions of smartphones that have been sold since the launch of Apple iOS and Android had created a strong market for software programs to service these smartphones. This software, known as apps, is where the company's product and service will be positioned.

The app market is extraordinarily diverse. Apps are available for games, health, news, entertainment, education, and more. A look at the Apple iTunes App Store shows that there are over two million apps available. To get an idea of how fast the increase in apps has grown, one can look to the data that shows then the Apple iTunes App Store opened in 2008, it had 500 apps. Google Play, and other dominant digital distribution has flourished also, well over a million apps are available on Google Play.

The strong presence of app stores in a positive for the company. A large portion of the potential customer base will not need to be educated on what an app is and where to get one. On the other hand, with millions of apps currently competing for coveted customers; it can be difficult to stand out from the crowd. The company will focus on developing a high-quality app and marketing it well as to allow penetration into the congested market.

The local development community, specifically in fashion technology, will be a strong resource network. Peers are not only mobile app developers; they also include marketers, Web designers, hardware specialists, digital content creators, third-party vendors, and more. The company will take pride on keeping a valuable, digital "rolodex" (basically, key social media contacts). For example, after our app is completed, the company will want to reach out to reviewers, tech and fashion journalists, fashion influencers, and local news media contacts, so that it can get some traction before deploying the SMM strategy.

Market Strategy

The mobile app development strategy is driven by solving a mass market problem in the fashion industry that involves creativity. The app must perform as well as it looks, and the way it is marketed must awaken the interest of end users. The SMM strategy will build a synergy between the product and the platforms where it can be obtained, namely the iTunes App Store, Google Play, and other possible digital distribution outlets *What Do I Wear?* can enter.

Through the quality of development and keen SMM, the app will stand out in the electronic marketplaces. We have additionally done a utility patent that is pending to grow the digital distribution outlet.

Creating a dynamic and robust online presence will be at the core of the marketing strategy for the company. Creating a website will be essential in developing presence. *What Do I Wear?* will have a multipronged marketing strategy aimed at ultimately driving traffic to the app download. To get customers there, it will execute on the following:

1. Having social media be prominent for improving the traffic download to the application.

2. Having company materials in partnered retail stores to market download.

3. Press articles featuring the application and its use.

4. SEO (Search Engine Optimization) – This will improve the websites visibility through search engines.

Specific areas of focus that will be important to promoting the app are:

- App store optimization – just like search engine optimization for the website, the company will spend time and money optimizing the app in the various app stores.

- App description: This is a very important area and the company will choose to use keywords in the title that will boost the visibility of the app in the app stores. The company will carefully track its own keywords and those of competitors. When changes are necessary they will be made.

- Reviews: The company believes that when an app is viewed in an app store and seen to have many positive reviews, it provides a comfort level to potential users.

- Video: A high quality informative promo video will be created. This video will take prominent role in promoting how to use the app, the features, and where is it available. This video will be embedded on our website, into the social media channels, it will be uploaded to YouTube channel, and it will be uploaded to the Google Play Store. The video promo will explain what the app does and why consumers would want it. The data is clear on video as a sales tools for products such as apps, and to draw in potential retail partnerships. Considering that video now appears in 70% of the top 100 search results listings, and that viewers are anywhere from 64-85% more likely to buy after watching a product video.

Once users have experienced the value of the app, the strategy will be to monetize. Support for the app in the marketplace via the marketing and distribution strategies, will drive potential users' and retail partners knowledge that the app exists.

Market Trends

The Business of Fashion stated that, "$1 trillion is estimated to be spent by global consumers on cross-border e-commerce by 2020" (McKinsey & Company, 2018, p. 32). A trend in the market is to develop an app that can be broadly distributed with the influencer market of advertising becoming a popular way for customers to gain inspiration on what to purchase and how to style it, customers are looking for this similar concept when they shop. Others are looking to digital

operations and capabilities recommended products based on the consumers search history and click history on social media as one example. There are now systems in China, "allowing users to generate outfit matches from hundreds of items, like a personal stylist" (McKinsey & Company, 2018, p.50). Customers want tailored and customized recommendations and solutions to their shopping. "Today, only 10 percent of startup companies consider machine learning to be a core business say they generate revenue" (McKinsey & Company, 2018, p.60). Customer experience is the frontier to building a strong and reliable business. ">75% of fashion retailers plan to invest in AI in 2018/2019" (McKinsey & Company, 2018, p.27). Machine learning is being employed into a number of ways to the fashion market, for the benefit of the consumer and the sustainability of fashion businesses. The mobile application I have built for this thesis project requires machine learning to solve a core business problem, being we over purchase to build a wardrobe that suits our personal style, lifestyle, and body shape however our over purchasing habits are impacting the simple task of getting dressed and our environment. This mobile application additionally has the potential to generate revenue.

The Competition

Competitors and type of Competition

The competition we are facing with our company's mobile app and future devices is through the personal shopping recommendation. There are lots of apps that currently do this. We have streamlined the utility behind how / why we are recommending clothing to each user.

Stylebook is an app that acts as a curated virtual wardrobe for you to experience organizing looks and tracking statistics on items you wear most to least. This app allows its users to style looks

themselves and save them, plan when you will wear specific looks, and save style inspirations in one place for you to develop your personal style.

Stitch Fix is a personal styling service that combines technology and professional stylist expertise to take in information of the client such as: personal style, size and price preference and will send hand-picked clothing items and outfits to send to the client's door.

Intelistyle is a web and app based technological output that uses artificial intelligence to source stylish clothing items and looks on the web that match your style direction.

Competitors' Strengths and Weaknesses

All of these devices and systems created by these companies are looking to assist people in personal styling in an attainable manner. This is a strength, because they are offering ways to assist people by sourcing clothing and build outfits that suit their body shape, personal style, and lifestyle.

The weakness all these competitors have is they create a strong skeleton for each user around clothing items that suit them, but they do not follow through on taking these factors and giving recommendations on outfits, on a daily basis.

Competitive Advantage

The competitive advantage our company has on current apps and services in the market place, is we work with our users from start to finish when curating a wardrobe and getting dressed daily. The *What Do I Wear?* app acts as a personal styling service, using artificial intelligence to match clothing that suits each independents user style direction.

Future Expenditures / Technology Requirements

What Do I Wear? will rely on the latest technology and technological advancements to deliver the business model. At the same time, we will keep an eye on which mobile devices are still relevant in the market. We have worked to introduce a new artificially intelligent database for uploading clothing into the application, and recommending outfits to the user.

The technology infrastructure will be designed to easily scale. Utilizing cloud services to host everything will provide the ability to keep costs down at the outset yet pay for added capacity as growth develops. The company will use a nimble development methodology which will break things down in milestones.

Innovation and end-user appeal are very important to the success of this app. The mobile app will expand very quickly, as fashion industry does, and *What Do I Wear?* intends to keep up with the explosion of different technological advancements both in and outside of mobile application technology, so that we can develop and monetize the app as soon as new devices hit the market. One of its next areas to focus on is the technological advancements in mobile devices, like artificial intelligence, augmented reality, and personality insight as three growing examples in the marketplace.

The *What Do I Wear?* app's general focus is to provide the end user with their own personal stylist and shopper. How often have you stood looking at your wardrobe full of clothing and said 'I have nothing to wear.' If you have, then this app is for you. This app will act as your own personal stylist and shopper reducing the amount of time and

money you spend putting together a coherent and acceptable outfit. *What Do I Wear?* is here to assist you in organizing your wardrobe, reduce the amount of unnecessary online and brick and mortar purchases you may be currently making, and start your day loving the outfit you are in. *What Do I Wear?* will allow people to get dressed and to purchase clothing that works their existing wardrobe. This app is a personal at home stylist and shopper pulling complete outfits from the users' current wardrobe, and shopping for clothing items that would work for you, and you do not own but should. The clothing we wear can impact our daily life and help us communicate who we are, but we shouldn't be doing this at a cost to our environment. The app is going to assist customers / clients put their best self out there while respecting the impact fashion is having on the landscape and here is how:

An important function of this app is to develop a 3D body profile allowing customers to both see the recommended outfit the app suggested, but to also have user's body profiles try one clothes from online retailers before the clothes leave the warehouse. Presently, the online shopping business is expected increase sales from $481.2 billion to $712.9 billion by 2022. Unfortunately, due to items being returned approximately four billion pounds of clothing, returned from online stores, is going to our landfills every year. Big business, online shopping and fast fashion has changed everything and it is affecting our environment. We would like to help change that.

Keys to Success

Most importantly, as a company entering the mobile app development industry, the keys to success are held by the choice of revenue models, marketing, and app utility. This is a

sector that offers multiple income streams, and the company intends to take advantage of the models that allow the highest success of monetization given its specific app. The company's success with also lie in forging a deep connection with the end users, who will obtain the app developed on a basis of:

- Free Download – monetization will come in the form of advertising
- Freemium – limit features of the app until app is paid for
- Subscription – monetization via user purchasing subscription to obtain otherwise blocked content
- In App Purchases – monetization will take place from users purchasing goods and/or services
- Data Analysis – for fashion brands and corporations about users spending and purchasing habits through style statistics

Human Resources

A main element in the successful execution of the *What Do I Wear?* business model is outsourcing. Outsourcing is often viewed as involving the contracting out of a business function - commonly one previously performed in-house - to an external provider. In order to develop the app and not incur large capital costs, the company will use the skills of outsourced freelancers. This is expected to significantly reduce the costs of the initial and ongoing development of the app. Hiring in-house app development employees can

prove expensive and the company intends to avoid this by outsourcing the bulk of development.

Outsourcing will provide the company with the ability to build the app at an affordable price by having:

- Cost savings — The lowering of the overall cost of the service to the business. Access to lower cost economies through offshoring called "labor arbitrage" generated by the wage gap between industrialized and developing nations.
- Knowledge — Access to intellectual property and wider experience and knowledge.
- Access to talent — Access to a larger talent pool and a sustainable source of skills.
- Scalability —The outsourced provider will usually be prepared to manage a temporary or permanent increase or decrease in production.

Management Team

Savaya Shinkaruk has a built a career for herself in the fashion industry working in different levels of sales. For her thesis project at OCAD University she saw a gap in the market of making her skills of personal styling and shopping available to the mass market. While building her company, she works for the *Citizens of Humanity* at the Canadian based Corporate Head Office.

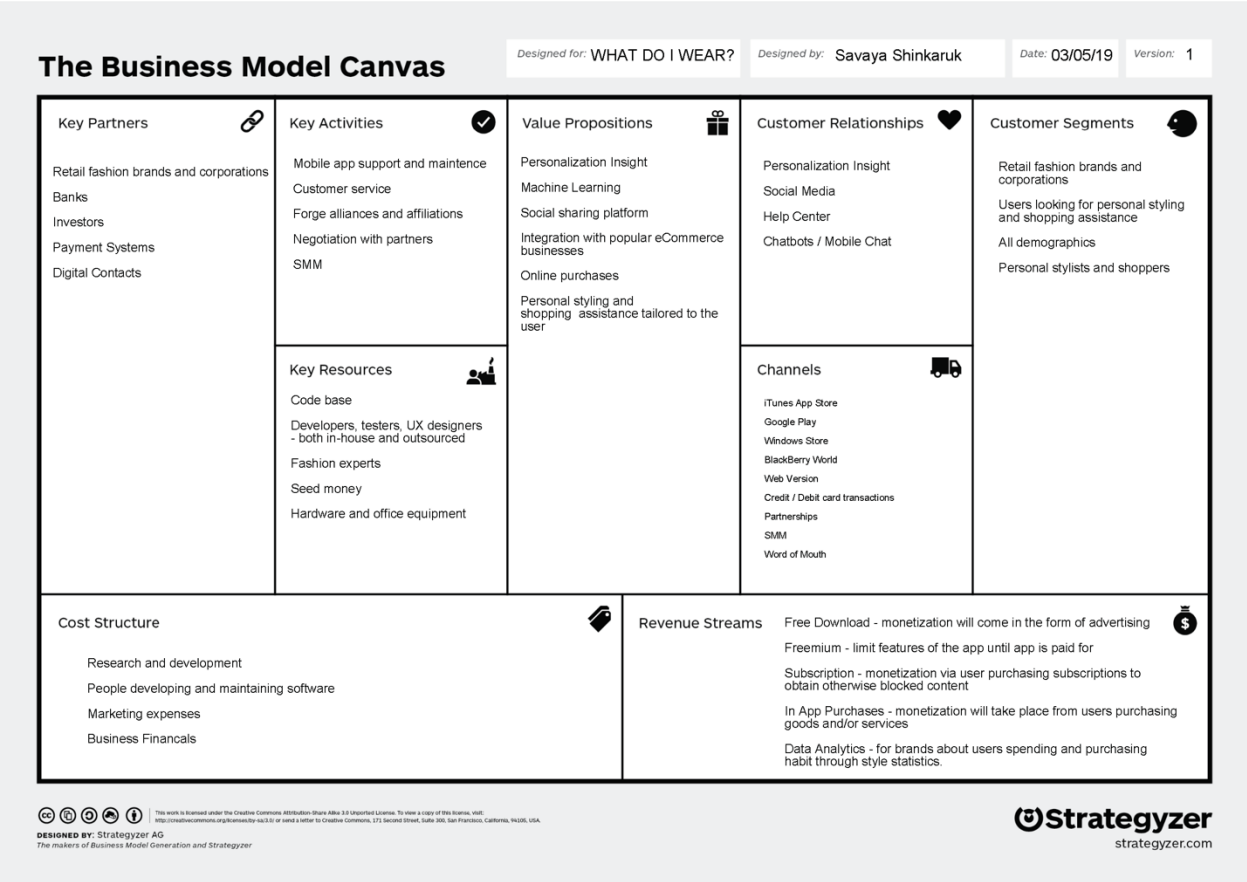
Kelby Price has been placed in the top 10 women in tech in Canada. She is certified professional in investor relations, and is a serial entrepreneur having exited her first

company back in university. She is currently the Vice President of Corporate Development at Labrador Technology, Inc.

Patricia Shinkaruk has been working in business management for the last 24 years, and has inspiring knowledge about the business side of fashion.

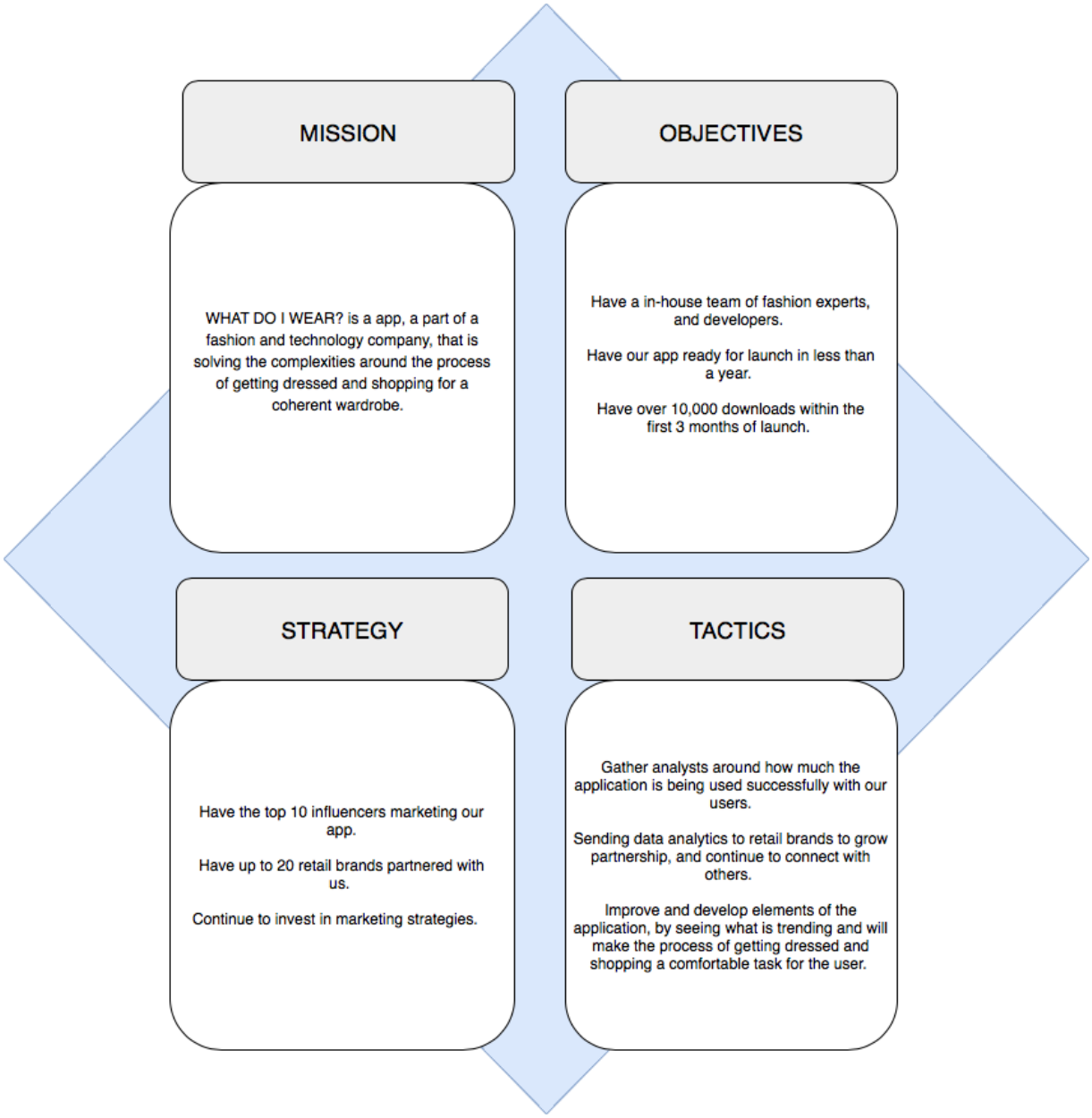
Business Model Canvas

The Business Model Canvas is the strategic management start-up template our company used to put together important information to mention in the business plan. This is to highlight our projections for the company and the mobile application we have produced.



M.O.S.T Analysis

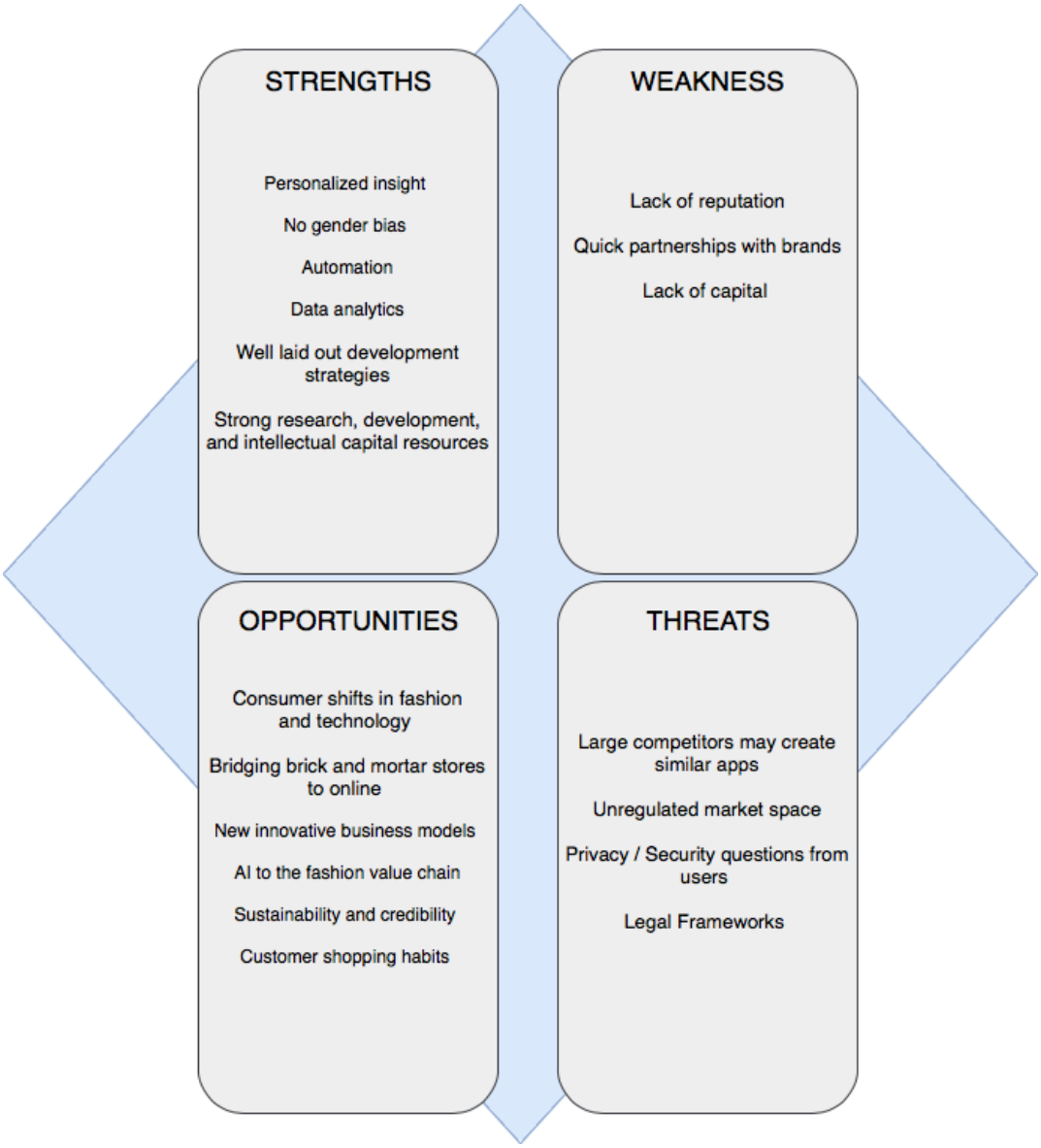
This analysis is a framework used for organizations to focus on the goals that matter the most when providing targets. Our company has identified what our 'aims to achieve' are through our mission and objectives, and how it 'aims to achieve' in our strategies and tactics.



MOST (mission, objectives, strategy, tactics) Analysis

S.W.O.T Analysis

This analysis is a technique we used to understand our strengths, weaknesses, opportunities, and possible threats this company can have in our start-up stage. We have identified and elaborated the criteria in each of these categories so we know what we need to focus on and achieve when building our plan.



SWOT (strengths, weakness, opportunities, threats) Analysis

The specific areas of our S.W.O.T analysis are:

Strengths:

- **Personalized Insight:** This app is focused to learn about each individual user that downloads it. Using IBM Watson Personality Insights we have positioned ourselves to understand our customers more, based on what they like to wear and what they are shopping for. The personal styling angle of our app is tailored to understand the user, and how they like to style their outfits and what clothing we should recommended to them based on personal style, body shape, and what clothing items they could benefit from in their outfit shuffle.
- **No gender bias:** The focus of this application is to look at the different fits, cuts, and styles of clothing items and recommended an outfit that would make the user feel most comfortable based on their body shape, styling preference, and the season. The language used throughout the whole format of this app is not gendered. We do not ask about the users' gender, we focus on the brands they like, the fit, cut, and style preferences, and pull data about the clothing items they have in their wardrobe such as: dress or jeans.
- **Automation:** We have automated the process of styling outfits for the user, and the ability to purchase clothing that suits the user. What we mean by automated is the app works to provide a start to finish strategy when working with each user to suggest outfits, and clothing they should purchase.
- **Data Analytics:** The data that is being pulled from the app from each user is tailored to retail fashion brands so they can see what customers are not only purchasing but are wearing most.

- **Development Strategies:** We have broken down the different versions of this app we want to build as time goes on.
- **Capital Resources:** We are a new concept. Our intellectual property drives our research and development because we know what we need to continue producing with our mission, and how to improve and introduce new technological advancements.

Weakness:

- **Lack of Reputation:** We are a new concept to personal styling and shopping for mobile applications. We do ask, if users will feel comfortable with this service we are developing and providing.
- **Partnerships:** We are a new company selling an idea to grow our key partner rolodex. We need to be confident in what we have because there is a large benefit to both consumers and fashion retail businesses.
- **Lack of Capital:** To date we have only invested personal money into our project financials. To grow this product, we need to hire a team to continue with the development as we are a product that is focusing on AI and machine learning.

Opportunities:

- **Consumer Shifts:** Consumers are the shifting force in fashion, and we are on trend to provide customers with a service that makes their shopping and interaction with fashion more personalized.
- **Brick & Mortar VS Online:** We have a product that will work for both the benefit of online and traditional brick and mortar retail locations, to have consumers purchase clothing they feel good in and will not return.
- **Innovative Business Models:** This is a new concept on the market, which puts our company in a position to be innovative. Our goal is to assist consumers in getting dressed and shopping, and to provide retail brands data analytics that they can use to guide their supply and demand of products. Additionally, use as an advertisement tool.
- **Artificial Intelligence (AI):** AI is trending in the fashion market. Businesses are looking at ways this technological advancement can create value for them.
- **Sustainability and Credibility:** Technology innovation is one way we can unlock efficiency for the supply chain for both fashion brands and retail stores. Through this way of thinking we are wanting customers to learn more about the clothing they are purchasing. Transparency is becoming more and more important to consumers. We want to open our data to assist retail brands in projecting their sustainability and credibility when it comes to their supply chain.
- **Consumer Shopping Habits:** Consumer shopping habits are 74% through social media. This app is another device consumers can use to shop for clothing items. This is where personalization is important again, and a major opportunity for us as a company.

Consumers are a driving force in sharing their opinions on what they want, when they want to shop. We will use this as an advantage to be one step ahead.

Threats:

- **Competitors:** Other mobile apps similar to us might advance their technology to work similar to ours. However, we have protected our intellectual property to try and slow this process down.
- **Unregulated Market Space:** Working in a technology field is tough because we have to move towards what is trending. And be careful to not introduce something too early where our users will feel uncomfortable to use it, because it is not well known.
- **Privacy and Security:** With our app pulling data analytics and personality insight from the users we have made sure to design a system where the data we are pulling does not trace back to anyone. All personal information is local to each users account.
- **Legal Frameworks:** We need to continue to make sure the regulations for our app are thought about. Especially when it comes to the privacy of our users, and how we collect data from the app.

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Appendix B: Database

To view the database I have built for my thesis is available upon request. Please click on the link below to request access to the file. An email will be sent directly to me and I will send the database file to you within 24 hours.