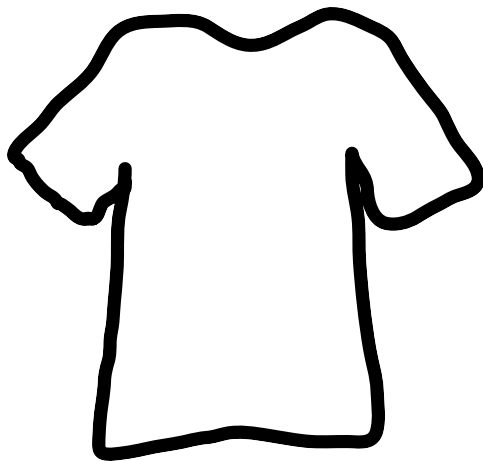


Used Clothing



A research report exploring
used clothing supply chains &
traceability.

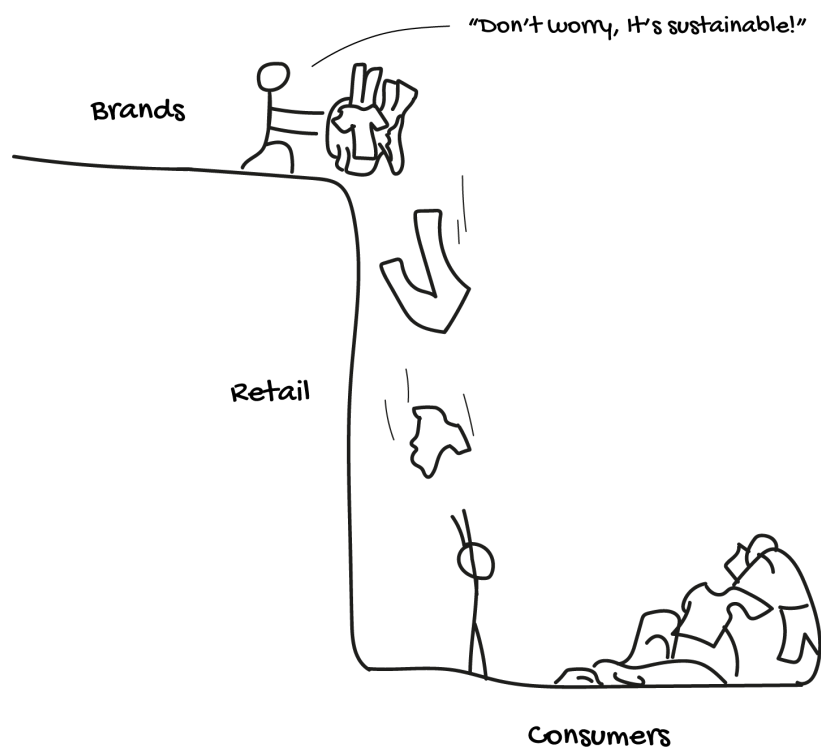
By Daniel Fisher

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Abstract

The fashion industry consists of new and used goods with an increase in the used goods market. Fast fashion has created an abundance of low-quality items that are not suitable for used markets due to the use of low-cost materials and production methods from profit maximising business models. Consumers have increased their adoption of purchasing used goods with research showing expectations for the market to grow in the coming years. This study was designed to explore the attitudes and barriers consumers experience when accessing new and used markets in an effort to identify a catalyst for used market adoption. Using mixed methods research of quantitative and qualitative research, surveys and structured interviews were conducted with 32 and 4 individuals respectively. The findings revealed several themes impacting consumers participation in the used market with "accessibility and convenience" being a barrier of used market participation and that through traceability the used market can better compete with new products. Implications for system designers and retailers are discussed.



1.0 Introduction

'Fast fashion' has been described as the production of clothing with, short product lifecycles, low quality and durability paired with low prices and high accessibility (Bick et al., 2018; Cruz-Cárdenas et al., 2019). Beginning in the 1990s fast fashion is a model used by large brands utilising rapid change in trends to achieve high profitability and expansion (Buzzo & Abreu, 2018). The introduction of social media and highly visual forms of communication through technology have bolstered the fast fashion model with global apparel manufacturing growing from \$610 Billion USD in 2010 to \$825 Billion USD in 2021 (Ibisworld, 2021). Such rapid growth and prime conditions for overconsumption have created waste problems around the world and with unsustainable processes riddled throughout the fashion supply chain, the impact of fast fashion on the environment and communities is compounded and scaled with the increased growth (Bick et al., 2018; UN, 2018, 2021; Zamani et al., 2017). Recent foreign correspondent reporting on the second-hand clothing trade in Accra, Ghana has highlighted the issue that fast fashion is having on communities (Foreign Correspondent, 2021) whereby 40% of purchased clothing is disposed of, creating an environmental catastrophe in communities outside of where the fashion is being consumed (Western nations). This impact of fast fashion is ironic as brand are now claiming traceability in their product offerings yet the information they offer is limited to production, and while the sustainable production of an item of clothing is important, brand have some obligation to see that their products do not end up affecting the environment after consumption. It might be said that currently brand send their clothing off a 'cliff' and into a second hand market where they are no longer the concern of the company that profited from their sale, there is an onus on brands to monitor where their clothes end up in order to make truly low impact products.

Areas of growth that are relieving the consequences from fast fashion consumption are used clothing markets. Used clothing markets provide consumers with affordable, sustainable and quality clothing items as well as providing a unique, ethical and sustainable alternative to purchasing clothes brand new (Park et al., 2019; Thredup, 2021). This research report explores the clothing consumption in new and used clothing markets, with a focus on flows and traceability in used clothing markets and post-consumer supply chains. The aim of this report is to identify ways consumers can decrease the impact of fast fashion by increasing participation in used markets through the reduction of barriers to consumers.

2.0 Literature Review

The following literature review explores literature in three spaces, Traceability of clothing in supply chains, consumer participation in used markets, and the role blockchain plays in apparel traceability.

Following an increase in ecommerce platforms like Ebay and Depop, consumers have more power in reselling and redistributing clothing in second-hand markets (Thredup, 2021). Used markets are an effective way of combatting the impacts of fast fashion (Bick et al., 2018) with consumers growing more aware of the effects of fast fashion on the environment, however, findings from research exploring consumer attitudes and purchase intentions for 'slow fashion' (a word used to represent sustainability, high quality and durability (Shaikh, 2021)) vary with research from Zhang et al. (2021) finding that consumer awareness of sustainability does not translate to purchase decisions, however, Warren et al. (2019) research shows that consumers intention to purchase slow fashion is significantly affected by consumer attitudes towards slow fashion, this shows there is some nuance to the relationship consumers have with sustainable products and their consumer behaviour is yet to be well understood. This idea can be supported by the fact that fashion is an individual's choice as opposed to a collective one and attitudes, awareness and consumption patterns vary (Shaikh, 2021).

Research exploring the consumer behaviour in second-hand markets is not yet in abundance given the complexities and breadth of players within the second-hand market. Park et al. (2019) has explored used-market participation through the framework of 'self-orientated' or 'others oriented', with findings suggesting that second-hand retailers should provide customers with a sizable selection of clothing with historical significance, authentic items and hard to find items. Conversely to consumers purchasing intentions, consumers donating clothing into the used market can be perceived as 'suppliers' and are required to maintain a healthy used market supply, Norum's, (2017) research highlights that the largest deterrent of used market suppliers donating is the physical condition of clothing – meaning non-durable goods such as products originating in fast fashion supply chains are not adding value to the second-hand market. This is also supported by research from Cruz-Cárdenas et al. (2019), where value is explored in the terms of reuse, Cruze-Cardenas et al. finds that durability is a key element to reuse and identifies that there is limited reuse potential for fast fashion items given the low-cost materials and manufacturing methods used.

Brands have used supply chain traceability as a response to fast fashion and counterfeit products with blockchain technology being embedded in supply chains to create transparency of materials and authenticity of product (Agrawal et al., 2021; Bullón Pérez et al., 2020; Maguire, 2019; Moncler, 2016). Although these use cases of transparency in supply chains are increasing transparency and security of products, there isn't incentive for organisations to

commit to such technology in a used market, and the models in literature are limited to pre consumer contexts, one such framework was created by Bullón Pérez et al. (2020) for the traceability of ready-to-wear clothing through blockchain technology.

While traceability of products can be executed through paper-based documents, inputting information to a secure blockchain increases the traceability of processes and technology such as RFID tags can automate such processes using near field communications, redefining what traceability in a supply chain means (Pigni et al., 2007). One of the limitations with the blockchain technology is that it requires collaboration with suppliers, with the entry of accurate information and trusted suppliers (T. K. Agrawal et al., 2021). Luxury Italian fashion brand 'Alyx' has adopted blockchain traceability for a select number of items, of which are produced by trusted suppliers all located in Italy, Alyx states that it is possible to trace these products as they have good relationships with supply partners (Maguire, 2019). The information Alyx collects in its supply chain is given to the customer via a QR code, however this is a read only state of the production information of the garments. Although brands like Alyx are using this technology for CSR purposes it seems the supply chain traceability is currently limited to a B2B capacity for the purpose of risk management in monitoring supply chain processes (T. Agrawal & Pal, 2019).

Current development of this traceability technology is focused on securing a readable product tag to a garment (T. K. Agrawal et al., 2018; Azuara et al., 2012; Chen et al., 2015), whereby doing so would give the readability of the garments tag authenticity across the supply chain. These emerging RFID technologies are expected to be applied after the manufacturing process but before consumption stage, meaning that there is a potential emerging field of study in traceability in used markets.

It is clear that research into traceability in a post-consumer context is limited at this stage, however, a paper by Bertola and Teunissen (2018) does highlight the opportunities for digital transformation to reshape the fashion industry to a more sustainable model, although it doesn't explore the post-consumer market specifically, but with digital transformation sweeping throughout supply chains due to Industry 4.0 the next logical step is for research into the digitalisation of post-consumer supply chains.

3.0 Methodology

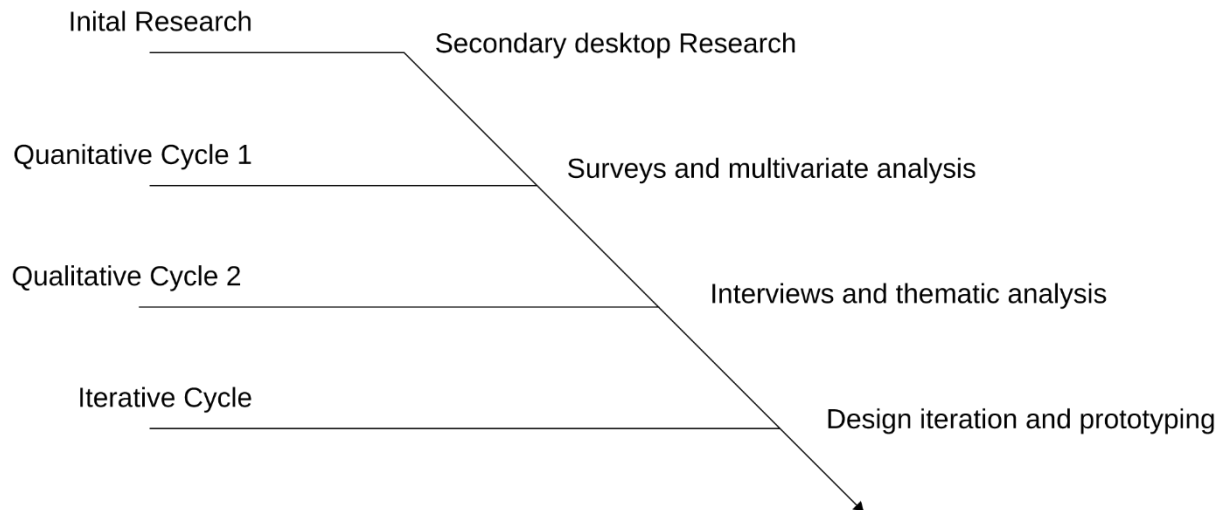


Figure 1: Research Design and Methodology

The research undertaken in this paper comprised of 2 cycles utilising 2 different methodologies, a quantitative cycle, and a qualitative cycle. The topic this report explores revolves around complex phenomena in a social environment, meaning it's important to explore the topic using different lenses (Creswell, 1999) hence the use of a mixed method approach. A mixed method approach is also beneficial in providing stronger and more reliable data with a higher potential for causal inference (Abowitz & Toole, 2010).

3.1.1 Cycle 1: Survey Methods

The Quantitative cycle was the first cycle of the research and consisted of a 9-question multiple choice survey with a sample size of 32 selected using a volunteer sampling. The survey focused on respondents most recent 5 items of clothing they purchased. The survey focused on these items for the purpose of understanding the proportion of used to new clothing purchased and where the disposition of that clothing would be. Clothing purchases were identified as 'Brand New' and 'Used' with flows of disposal being categorised as, *Garbage*, *Resell*, *Thrift/Op shop*, *Store/keep*, and *Gift*. To identify where consumers dispose of their clothing the analysis grouped the items into 'entering/re-entering the used clothing system' and 'held from the used clothing system'. Clothing was identified as entering the used clothing system under the responses; 'Thrift/Op shop, Resell or gift' and leaving the system if responses were 'Garbage or Store'. This analysis method allowed the respondents to be analysed using multi-variate analysis whereby respondents were grouped into segments

based on the ratio of new to old clothing they purchased, and of those that 'Purchase Used clothing', 'Purchased mixed clothing' and those that 'Purchase New Clothing'. These segments could then be compared to respondent's respective disposal habits and contrasted to better understand how clothing flows in a second-hand market. The quantitative aspect of the research design was beneficial in selecting respondents for the qualitative part of the study by enabling a stratified sampling technique and selecting a proportion of those that 'Purchase new clothing' and 'Purchase used clothing'.

3.2.1 Cycle 2: Interview Methods

The qualitative cycle of this report consisted of 4 exploratory interviews with selected respondents from the survey. Using a stratified sampling method enabled respondents' habits to be proportional, meaning the analysis of responses would not be skewed in favour of used or new clothing and a variety of opinions and themes could be analysed. The interviews consisted of 24 open ended questions, categorised as '*Brand new clothing*' '*Used clothing*' and '*Traceability*'. Interviews were completed and transcribed with two layers of thematic analysis completed. Themes that were identified in the analysis were *Sustainability*, *Accessibility/Convenience*, *Uniqueness*, *Brand/Label*, *Materials*, *Style/Fashion*, *Quality/Condition* and *Price*. Themes were scored and analysed visually in the proportions to their frequency, most frequent themes were *Style*, *Uniqueness* and *Accessibility/Convenience*.

4.0 Analysis and Findings

4.1 Survey Data: Table 1

Results from the survey data showed that more items of clothing are purchased new with 59% of respondents clothing being purchased new and 41% purchased used. These findings show that the used market is accessed almost as much as the new market. Secondly, it is found that there is minimal evidence showing that respondents purchase habits affect their disposal habits as seen in *figure 1*, almost all respondents intend

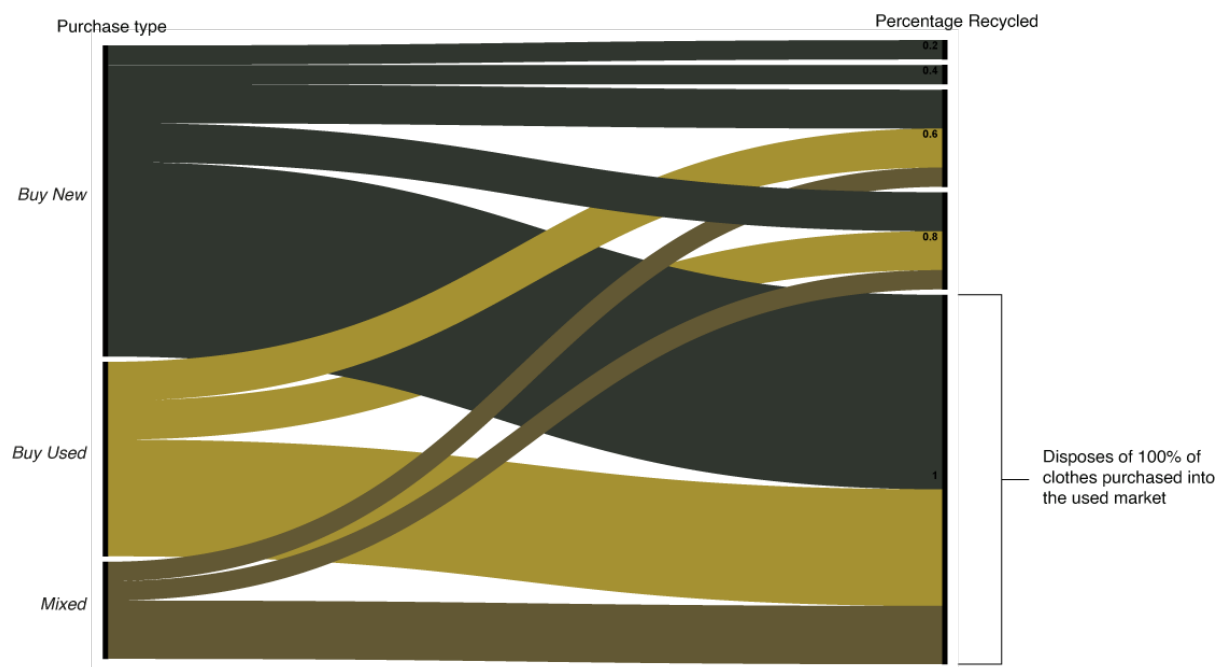


Figure 2: Multivariate Analysis of Survey Responses

Table 1: Survey Response Results: Disposal Methods

Thrift store	79	155	51.0%
Reselling	22	155	14.2%
Gifting	32	155	20.6%
Garbage	4	155	2.6%
Storing/Holding	18	155	11.6%

on disposing of their purchased clothing into used markets with the mean and median of clothing disposal to be 100% disposed into used the used market/recycled. Those classified as respondents who 'Purchase used clothing' had an average recycling percentage of 88%, the same as those who purchase a mix of new and used, whereas those who purchase new

clothing had a recycling percentage of 84%. This suggests that people who are purchasing clothes brand new are not accessing the used market as much as those that purchase used and mixed. In total, the amount of clothing respondents recorded as recycled was 85.8% with only 2.6% of the remaining clothing directly ending up in the garbage from the respondents' hands. The other 11.6% of clothing was recorded as being 'Held/Stored' meaning its kept by the respondents and respondents have no intention of it entering the second-hand market.

4.2 Interview Analysis

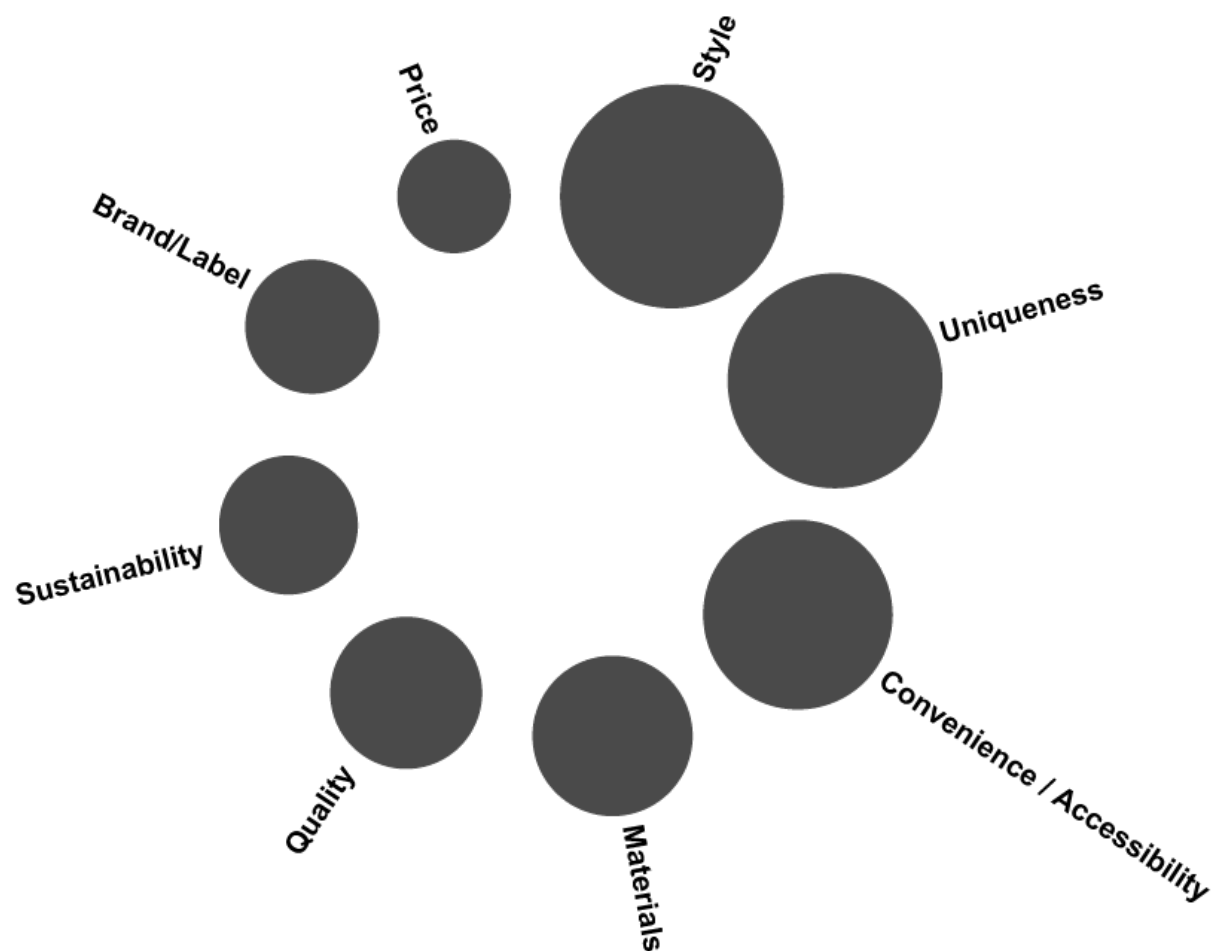


Figure 3: Interview Thematic Analysis

Table 2: Interview Themes and Example Quotations

Theme	Quote
Uniqueness	<p>"Its usually not something that is fast fashion, it is something that is often a bit older and unique"</p> <p>"I remember it more because it's unique, because it's second-hand"</p> <p>"I'm looking for stuff with character and the new stuff doesn't do that for me"</p>
Sustainability	<p>"I wouldn't support fast fashion and cheap clothing brands like H&M"</p> <p>"It's just a practise of supporting sustainable and ethical fashion"</p> <p>"I prefer to purchase used clothing for sustainability and fashion reasons"</p> <p>"I guess from an ethics point we are not creating more products"</p>
Price	<p>"The old vintage became more attractive, as well as being a lot cheaper than everything else (New clothes)"</p> <p>"It is a lot cheaper, and you get weirder, more interesting items"</p> <p>"[Why purchase used] Just the price really"</p>
Availability/Convenience	<p>"Sometimes op shops don't have what you're looking for, or the size"</p> <p>"It's just more available (brand new)"</p> <p>"I can't be bothered to sell clothes"</p> <p>"It is just inconvenient to get rid of them"</p> <p>"I purchase for quality, something I know I won't be able to get second-hand"</p> <p>"I think with brand new clothes it is a lot easier to find what you want"</p>
Brand/label	<p>"Cheap clothing like H&M an stuff like that"</p> <p>"If a brand has a good history of clothing and a general aesthetic then I am definitely going to swing toward the brand"</p> <p>"I feel lovely when I get a brand spanking new Uniqlo Shirt"</p> <p>"Authenticity of brand? No I have never worried about that"</p>
Style/Fashion	<p>"It's just a practise of supporting sustainable and ethical fashion"</p> <p>"I prefer to purchase used clothing for sustainability and fashion reasons"</p> <p>"I prefer to purchase silks and poly blends...mostly because of the fashion, I think it was done better like that"</p> <p>"Vintage became more attractive and unique"</p>
materials	<p>"I prefer to purchase silks and poly blends"</p> <p>"[Are there materials you prefer to purchase second hand] Heavier cottons...they last, and they wear well...that's probably the number 1 material I would go for."</p> <p>"The pants I am wearing now (heavy cotton) are second hand"</p> <p>"[Are there materials you prefer to purchase second hand] yeah – proper textiles – cotton – that sort of stuff"</p> <p>"Cotton blends are nice from aussie manu"</p>
Quality/Condition	<p>"If it looks clean, I would be happy to wear it"</p> <p>"You know its new and are not expecting defects"</p> <p>"If they are 'rag' level I will dispose of them in the bin"</p> <p>"I am open to all types of material second hand"</p>

The interview Analysis identified 8 themes, those being *Sustainability, Accessibility/Convenience, Uniqueness, Brand/Label, Materials, Style/Fashion, Quality/Condition* and *Price* with examples of these themes in *Table 2*. The most prevalent themes in the interviews over all were *Style, Uniqueness* and *Accessibility/Convenience*. Respondents' values varied with respondents mainly choosing the second-hand market because of sustainability, cheaper prices, and a wide range of unique items. Participants used the *new market* for ease of access, quality expectations, exclusivity and for underwear and socks.

Style was an important factor, *Respondent 1*, a respondent that only purchases used clothing in the second-hand market states he prefers purchasing used clothing for "fashion reasons" and that the "fashion appeal" is why used clothing is his preference. Conversely *Respondent 2*, a respondent that only purchases brand new clothing, states that the second-hand market doesn't have what they want or often don't have the correct size. The theme of accessibility/convenience can be viewed as the largest deterrent of used market access, as most respondents mentioned they will choose brand new clothing over used clothing because they can get what they want, when they want it.

A common theme across respondents' interviews was that there was a preference for cotton and natural textile materials in a second-hand market, synthetics are not as desired. Participants were questioned on how they felt about an item's traceability and the history of an item being relevant them, all participants felt their purchase intention would increase if they had a personal connection to an item of clothing's history. Similarly, respondents also stated they would be more likely to purchase second-hand goods if they could verify the authenticity of goods in used markets.

Respondents all stated they dispose of their clothing in the garbage when it reaches 'rags level' indicating that the item of clothing is no longer suitable for wear, it was also indicated they a respondent would not feel 'good' donating 'rags' level clothing to an Op Shop. It is also relevant to highlight that use of the second-hand clothing market is unique to each consumer, respondents had a variety of opinions and different combinations of reasoning for choosing new or used clothing with different weightings of the identified themes throughout respondents' responses.

5.0 Discussion

It was found that respondents dispose of almost all clothing into used markets regardless of the origin of purchase, this highlights the importance and sheer volume of the used clothing market in society, supporting findings by ThredUp (2021) that the second-hand industry is growing. Given the importance of the used clothing market on alleviating impacts of unsustainable fashion practises it should be further understood to strengthen, maintain, and promote used markets in the clothing industry.

5.1 Brand New versus Used

It was found that consumers choose brand new over used clothing for convenience, easy access, and quality expectations. For the most part brand new clothing has a clearly traced origin and the information associated with its production, materials, style, and cut is crucial to its marketing mix, so by design brand new clothing has its meta data clearly laid out for the purpose of making sales, if new clothing lacked the meta data that makes it so easily found across the internet and in stores it can be assumed there would be similar issues of accessibility arising, as found in used clothing markets. Secondly, given that used markets alleviate impacts of fast fashion it is important used clothing remains competitive against new clothing, used clothing has several competitive advantages against new clothing, particularly its unique style and fashion that is associated with historical items, and the price point that quality garments are sold at in the used market. Although used clothing has these qualities over brand new items, an extremely diverse product mix makes the processing of used clothing meta data impractical on scale, conversely brand-new clothing produced in batches can list meta data online for consumers to find and purchase. Being difficult to scale, used clothing has been widely adopted by individuals on emerging platforms like Depop, Etsy and Ebay, whereby the labour cost associated with listing the used garments are worth the time of the seller given the small scale at which they are listed, alternatively large scale used clothing retailers such as Vinnies, an Australian thrift store, simply stock clothing and rely on highly involved consumers to sort through racks in order to find something they wish to purchase.

5.1 Traceability of used clothing

The second finding in this study was that consumers value personal connections to clothing and state it would increase their purchase intention if an item of clothing was significant to them. The historical value of clothing is also valued by consumers in second-hand markets, yet there is no way for someone without experience to determine a products history or it's origins, this could be valuable information that could potentially turn an item of clothing from

waste to wardrobe. Traceability of clothing not only provides valuable information to brands and intermediary sellers, it allows consumers to connect with clothing personally. Traceability of used clothing has the potential to leverage the history of clothing and increase the value of clothing items in used markets, bettering the competitive advantage of used clothing in the wider fashion market.

6.0 Design Implications

6.1 Increase accessibility of used clothing

The first design implication from this study is that by increasing accessibility of used clothing, consumers can participate in the used clothing market and reduce their reliance on new markets. An increase in accessibility would come in the form of consumers being able to easily search for desired garments without having to sort through thrift shop stock. Accessibility of used garments should be comparable to new garments, so that more sustainable choices are easier for consumers to access. Doing so would reduce the demand for new clothing and increase value of stock to intermediaries, sustaining more environmentally friendly business models such as vintage stores, thrift stores and individuals reselling articles.

6.2 Leverage historical significance of clothing through traceability.

The second design opportunity is to leverage the historical significance of used clothing, this study shows that consumers of new and used clothing increase their purchase intention based on the history of an article of clothing, and given that some clothing requires an expert eye (Thriftcon, 2020) to determine historical value, by enabling all consumers to understand, see and judge clothing based on its historical significance, consumers would be able to make more personal connections to clothing, adding value to the used-clothing market. There are opportunities to embed meta tags onto clothing using RFID and Blockchain technology given the low cost of RFID devices and high security and traceability of blockchain technology.

6.3 Brands participation in used markets

Brands today are incorporating used clothing into their business models with product offerings including refurbished or recycled goods (Nudie, 2021; Patagonia, 2021). Increasing brands participation in used markets would further promote the adoption of used clothing, furthermore by enabling brands to profit from sales in used markets through intermediaries the increase in demand for second-hand goods would promote brands to create longer lasting goods that are intended on changing hands between consumers in the used market. Enabling business models that profit from used markets will promote quality and durable goods that can decrease the impact of product while maintaining brand profitability.

6.4 Embedded meta data in used clothing

The final implication of this report is the problems associated with embedding secure meta data in garments. By embedding meta data in garments systems can be built on used market

products that increase scalability and formalise the used market. Given the nature of the used market and bad actors that already exist in the fashion industry, securing meta data is a complex issue that needs to be overcome for any embedded device to truly integrate used clothing into digital systems. Without a secure way of embedding data, information of garments and traceability in the post-consumer market cannot be reliable or accurate.

Today we have seen brand like Moncler embed RFID tags into garments for the purpose of authenticity, yet these are still replicated in the counterfeit market (Moncler, 2016). An embedded tag needs to be tamper-proof, last with the wear of the garment and be accessible to all stakeholders in the supply chain. Information stored on the embedded data device will require input from the manufacturer or trusted parties, this limits the impact such a device can have on existing vintage garments currently in circulation.

7.0 Conclusion

In conclusion the impacts of fast fashion and overconsumption can be reduced through the increased participation of consumers in the second-hand market. There is limited research on supply chains beyond the consumption stage, yet the digitalisation of supply chain management does show some prospective developments in traceability and embedded technologies (Bertola & Teunissen, 2018; Pigni et al., 2007; Zamani et al., 2017). This study explored consumers attitudes and habits when interacting with new and used markets by using quantitative and qualitative methods. It was found that most consumers actively participate in second-hand markets regularly, but barriers are present for some when it comes to accessing or finding desired products. It is expected that with an increase in availability and accessibility in finding and purchasing used clothing the second-hand clothing market could have a greater impact in reducing the effects of fast fashion and promote a more sustainable industry.

Implications for designs attempting to increase used market participation include challenges in embedding meta data into used and new clothing in a secure way, enabling brand participation in used markets, increasing accessibility of used clothing, and leveraging the historical significance of used clothing through traceability.

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