POLITECNICO DI MILANO

School of Industrial and Information Engineering

Master of Science in Management Engineering

INNOVATIVE TOOLS FOR THE PREVENTION OF PRODUCT RETURNS IN E-COMMERCE

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September 2021

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Abstract

While online shopping is widespread, the online retail experience still exhibits problems. One of which is the center of this study: product returns. Returns are interdisciplinary by nature, which makes them harmful for several areas of a company. They represent about a third of sales on average, going up to 70% in some cases. [1][2] They are a trigger for churns and can affect profit if not kept under control. This poses a challenge for companies of understanding customers' behavior and the factors that influence their purchase decision, intending to comprehend its real impact and discover innovative ways to counter the consequences.

For online retailers, technology is the base of their operation and therefore, should be part of the solution. Tools like AI or AR are widely suggested to enhance the online experience and fight against returns, since they address the lack of contact with the customer and the poor understanding of a brand's offer, providing retailers with a competitive advantage.

This study pretends to tackle the main causes of returns that can be prevented, meaning the ones that correspond to the pre-purchase and purchase phases, to propose the most suitable solution to each one of them. The first chapter introduces the topic by showing the main trends expected this year for e-commerce, like its growth, customer experience, personalization, fulfillment, and technology enablers. The second one focuses on returns, explaining the main problems like fit or non-conformity, and the impact on operations and the environment.

The last and most important chapter provides a clear view of four of the most discussed tools in the matter. The first part describes distinct models for a fit assistant, the second explains different ways to use artificial intelligence to influence the reduction of returns, the third part describes how augmented reality can be used to favor conversion, engagement, and low returns, while the last one gives a short review on 3D imagery for visualization. For each one of them, cases of study are provided with real-life examples of the successful implementation of these tools.

Problem Statement

Returns have always been considered a problem for companies, but its effects were not severe before the expansion of e-commerce and the need of customers for instant gratification. Before this, many companies focused their efforts on solving the operational element of the return problem, concentrating on the decrease of complaints related to quality and delivery issues. However, it has been proved to be insufficient, as most cases relapse on the customer.

Just recently companies have started to focus their attention on the prevention of returns through the control of customer experience and buying decisions, instead of implementing strategies to decrease the impact on them. That is why plenty of businesses are not aware of the tools available for this purpose, and there is still a gap in knowledge and skills that prevent companies to dabble in the world of technology.

Though advantages of the usage of technology to manage customer behavior in order to lower returns are oft-cited, data to confirm it is spread out among countless sources. Moreover, information is little, unclear, not easily understandable, not reliable, and many times not available. It hinders companies or people to have a first contact with the potential solutions to the decrease of returns.

Objectives

The purpose of this study is to conduct a logical and clear review on the characteristics and effects of technological tools like fit assistants, AI, 3D models, and augmented reality, and how they create value for online retailers by impacting customers behavior to prevent the causes of product returns and improve companies' performance in general.

The main motivation for this research is to provide an aggregate of diverse data sources related to this topic to give a sense of the reality and current statistics on the matter to explore the relation between digital user experience and product returns and demonstrate it through cases of companies that have dabbled into these trends.

Additionally, as this study is a general overview, it is expected to create a common understanding of the topic and guide future research by offering different possibilities to deepen.

Methodology

The present study can be categorized as a cumulative review on the use of technology in e-commerce to prevent product returns linked to customer behavior. It is qualitative, entirely based on secondary data collected from articles, case studies, journals, published reports, blogs, companies' websites, and others.

This work gathers, evaluates, and synthesizes significant literature on the topic to provide readers with a broad description of the current state of knowledge in the area and inform them about potential future research. To ensure the accuracy of results, it employs a structured and consistent search method to identify relevant information and collect a complete sample of published data, followed by the compilation and classification of findings that are thematically similar, to make sense of the data and systematically summarize it. In the end, characteristics of interest are extracted to compare the different technological tools researched and provide a conclusion.

Such approach is adopted as the area of research is broad, and sources of data are few and spread across multiple sites, thus, findings represent a "state of the art" for the cited topic.

Chapter 1: Trends in e-commerce

Different sources converge in some trends that are expected to lead e-commerce in 2021 and the subsequent years. This study pays special attention to the specific factors that demonstrate the importance of innovation and technology within e-commerce, and directly or indirectly impact the prevention of product returns.

E-commerce on the rise

The e-commerce market has grown to become a shopping ecosystem integrated by several devices and store concepts, instead of just being a complement of brick-and-mortar retail. Nowadays, the e-commerce environment is seen as a relatively mature market with clear rules and established players. However, this notion can be deceptive as digital transformation is not over yet and is unlikely to ever come to an end.

In 2020, more than 2 million people purchased online globally, generating almost 4.3 trillion U.S. dollars, which represent 18% of the total sales in retail. Below can be seen the continuous growth of e-commerce in the past 7 years, being 2020 the one with the highest increase in comparison to the previous year. From 2021 to 2024 e-commerce will keep rising to reach more than 6 billion U.S. dollars. [3]
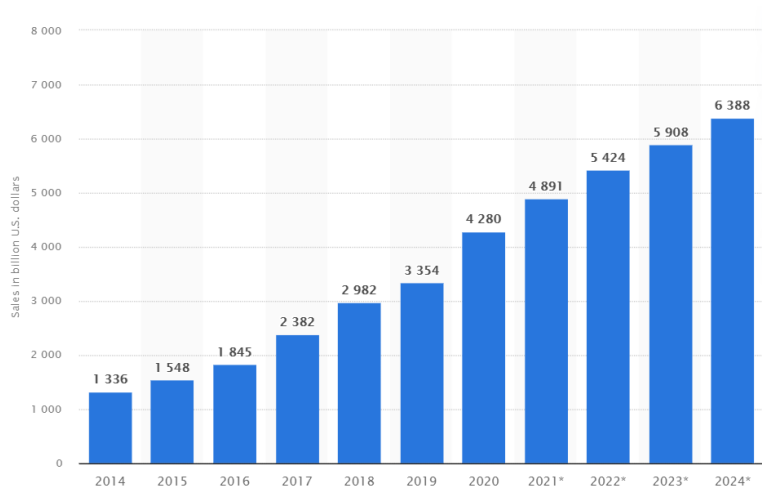
Figure 1. Sales growth in e-commerce from 2014 to 2024 [3]

According to the 2021 report "E-commerce worldwide" from Statista, the growth of e-commerce in 2020 was concentrated as expected in U.S., China, and Europe. China was the largest market with worth close to US$1,343 billion and is projected to be on top at least until 2025. Revenues are likely to grow at a CAGR1 of 8.2%, resulting in profits of US$1,996 billion, with the fashion industry as their main segment. In the U.S. market, revenues of US$537.7 billion were generated in 2020. Following is the U.S. market, with revenues of US$537.7 billion produced in 2020. It shows the second-largest growth rate for 2025 with a CAGR of 6.1% and revenues exceeding US$723

billion. The third biggest e-commerce market in 2020 was Europe with revenues of 460.5 billion, largely due to the Covid-19 crisis that generated a 10% additional growth compared to the previous year. [6] From this point, an estimated annual growth rate of 7.3% will lead to revenues of US$655.6 billion by 2025. [3] As well, developing countries such as Malaysia, Singapore, and Thailand are predicted to show sales increases. [4]

Growth varies for different categories of products:
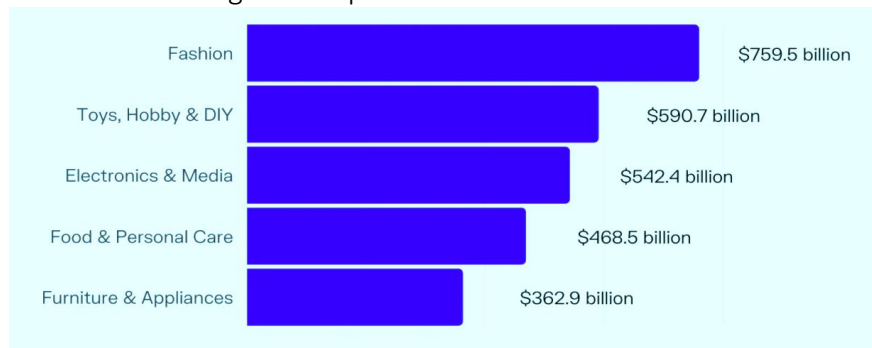
Figure 2. Top online shopping categories worldwide in 2021. [5]

Of the total e-commerce expenditure worldwide in 2021, consumers are projected to spend $759 billion on the fashion industry, meaning almost 28% of the expected e-commerce revenue in 2021. [5] This rate is particularly important given that on average 30% of clothing purchased from online merchants is returned, making it the focus of this report. [1]

Spend on Toys, Hobby &DIY products is 590.7 billion while food and personal care account for 468.5 billion, both affected positively by the Covid crisis. Electronics are in third place with 542.4 billion, while furniture & appliances make it to the fifth position with 362.9 billion. [5] This last category deserves special attention given the dimensions of products and the issues that can pose in the delivery.
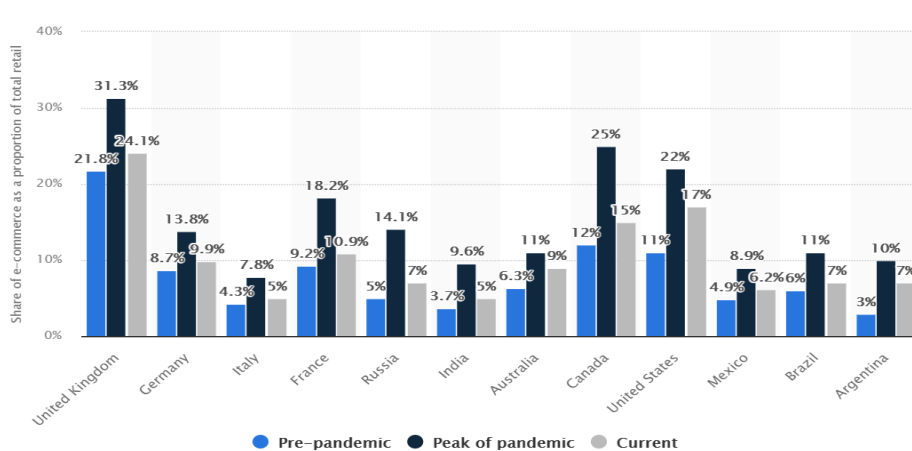
Figure 3. E-commerce as a proportion of retail before and after the pandemic [3]

The Covid-19 crisis played an important role in the expansion of e-commerce. Around March-April 2020, during the peak, many countries introduced lockdown measures, causing e-commerce share in total retail sales to reach proportions never seen before. In most countries, e-commerce share reached rates as high as 20-30%, before stabilizing in the subsequent periods. Even so, is clear the effect of the change in lifestyle and shopping habits since every country exhibits growth in the post-pandemic scenario. United Kingdom (24.1%), United States (17%), and Canada (15%) are the leading countries, with the highest share as a proportion of total retail. [3]

2021 expects to build on the momentum triggered by Covid-19 trying to leverage the tools and trends that make it a significant year for online shopping. In the last year, about 150 million new shoppers in the U.S emerged because of the physical restrictions imposed on stores and businesses. [17] This is proof that right now is the best moment to be invested in online companies, but is also clear that competition is rising quickly, making differentiation a priority. The brands that adapt to this fast-moving environment, will survive, thrive, and gain competitive advantage for years to come.

Customer experience is key

According to the International Data Corporation (IDC), the customer experience is an ecosystem depending on four factors: An active conversation with the customer that leads to contextual awareness, a frictionless journey designed to specifically engage each customer, an immersive and participative experience that fosters active learning, and finally the sentiment of satisfaction, consequence but also triggers of the other factors:
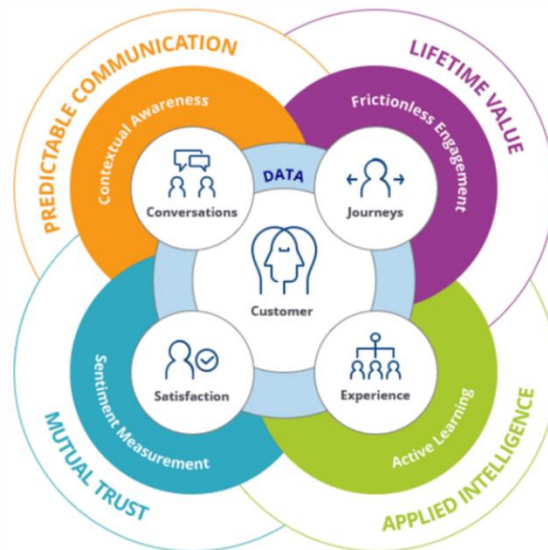
Figure 4. The ecosystem of customer experience [7]

In this ecosystem, companies must build a halo of data, using emerging technologies that fulfill customer expectations and provide better business outcomes for buyers. Specifically for experiences, the IDC highlights 3 pillars that will set the path for the future of e-commerce: smart personalization, customer adventures, and emotional engagement, all reciprocal to the other

factors of the ecosystem. [7] Smart personalization is linked to the use of data to offer a custom-made experience for buyers, which translates into adventures based on interactivity and enabled by technology, both expected to transform the relation of the customer with the company to unleash a feeling of satisfaction that will engage the customer.

In the past years was already seen the tendency of customers to prefer e-commerce, particularly virtual experiences, instead of going to a store. The challenge for this year and those to come is to convert in-person shopping into digital experiences that are close to reality, as customers are demanding.

There is a common desire for life-enhancing experiences that has led customers to expect retailers to provide an atmosphere where shopping is an event experience on its own, i.e., customer adventures. The desire for shopping experiences will deepen as many consumers become eager to showcase their participation in activities on social media, leading retailers to align their shopping experience to the consumer desire for encounters worth sharing, meaning interactive, highly engaging online and real-world retail environments.

Customer behavior, on the other hand, is affected by the perception they get of their journey and how the company treats them, when customers feel appreciated, companies gain measurable benefits as many customers use shopping as a leisure activity and are increasingly drawn to lifestyle brands. [8] A PwC survey found that around a third of customers worldwide will leave a brand they love after just one bad experience. [9] Conversely, 65% of US respondents believe that a positive experience is more persuasive than the best of advertising [10], thus, the provision of distinctive and substantial shopping experiences tied to innovation, will enhance, and distinguish a brand's value proposition. The brands that stick out will bring 5.7 times more revenue than competitors that lag in customer experience since customers are expected to spend up to a 16% price premium on products and services when a better CX is perceived. [9] Likewise, it increases retention, loyalty, CLV, brand equity, referrals, and growth, which translates to revenues. It was found that 89% of executives backed the idea that 'customer experience' is one of the main points to excel in achieving competitive advantage. [8]

Firms that incorporate digital transformation into their operation are 26% more profitable than their peers. [11] A survey developed by the MasterCard Economics Institute state that companies develop their digital tools and services along with consumers' preferences, which explains why 47% of innovation leaders will direct their customer experience strategy in the next year to raise customer expectations for new technologies. [12]

For now, video continues to be the most feasible way to get consumers' attention. A survey found that 78% of marketers say that video in e-commerce increases sales, while 94% say video improves product and brand understanding. [13] However, most innovative companies are experimenting with artificial intelligence and augmented reality to compensate for the lack of interaction, improving customer experience, and lowering returns. They expect that an immersive and interactive shopping experience responds to the need for physical encounters. Aurélien Vaysset, CEO of Emersya stated that interactive 3D product experiences offer consumers the autonomy to discover products online as though they were in a store while obtaining enriched content and customization capabilities. [14]

Personalization

As mentioned above, personalization is one of the pillars to build a strong customer experience, and nowadays, is considered a "must-have" feature for companies. Since consumers have come to expect a high level of convenience in their relationship with retailers and brands, personalization has turned to be crucial to offer a service that fulfills the expectation of a highly diverse customer base. In a survey of the company Accenture was found that 48% of consumers have left a website without purchasing because they felt it was poorly curated for them. [15]

Personalization is always supported by data. Data insights and analytics are the keys to help businesses to understand the customer's needs and preferences, identify opportunities and define a curse of action, all synchronized to provide the best experience possible to specific audience segments in real-time, and through any digital connection. Regardless of the segmentation technique that is used, personalization implies a need for a differentiated product and service delivery approach and the need of discarding the outdated "one size fits all" approach. Since personalization goes beyond product discrimination, the most important part relapses on getting a good reading and reaction to emotional cues that allow the company to generate dedicated strategies for customers.

Personalization not only helps companies to deliver a better customer experience (89%), [16] but it drives impulse purchases and helps to build solid customer relationships, with 78% of people claiming it has a "strong" or "extremely strong" impact, leading to the increase of loyalty (61%). [15] The Boston Consulting Group states that 40% of consumers are more likely to spend more than they had planned when experiences are highly personalized to them, while the marketing group Epsilon, states that 80% of consumers are more likely to purchase when brands offer experiences personalized to them.

One of the main benefits of personalization is that it enables upselling and cross-selling strategies fueled by personalized product recommendations. [13] Recently, sophisticated algorithms are allowing programs to interpret new types of data (visual, auditory) to infer emotions more effectively than in the past, generating measurable lift/ROI and helping to reduce returns. [15] Amazon is ahead of the curve on most of these trends, including personalizing their homepage to reflect previous purchases, searches, and recommendations for similar products. They also patented new features in their Echo device that will enable the detection of illness. It will later propose a proper recommendation, which can then be purchased over the device for at-home delivery. For instance, it can detect nasal tones that indicate a stuffed nose and continue to recommend and order chicken soup and cough drops. [8]

This makes clear that personalized and interactive online shopping experiences have led to greater adoption of technology. Moreover, people now accept that personalization is enabled by sharing personal data and are increasingly joining the trend. Content streamed to connected displays will be designed in real-time to predict and target the needs of consumers based on local conditions, such as the geolocation of the screen, device type, browser, connection speed, the time of day, and even the weather, enabling multi-purpose strategies that drive customer satisfaction. [8]

Customers expect fulfillment

E-commerce, likewise, is evolving to serve a time-stretched and more demanding shopper that is used to have all they want at their fingertips. This need of customers for complete end-to-end service is one of the trends that will spread and drive growth for e-tailers, as was stated by the marketplace Shopify in his last report, "The future of e-commerce in 2021". [17]

Online purchases come with a certain level of risk with respect to product quality or size. Moreover, the customer must wait for the purchase and the execution of service delivery. [18] According to Ulrich, product differentiation take place along three dimensions determined by how a consumer change its evaluation of a product based on a change in one or more attributes of it. The first is *fit*, where consumers' preferences have an ideal point, and variations from it lower the product's value. The second is *taste*, where consumers have multimodal preferences, and the value of the product has peaks and valleys. The last one is *quality*, where consumers prefer more of the positive and less of the negative attributes, adjusting for price. [19]

Fit, taste, and quality are general parameters to understand how to aim for the fulfillment of customer expectations when these are related to the product, which accounts for most of the purchase. However, a big difference between customer expectations and customer experience can be detrimental to the business just as much as quality, which is why brands are automating inventory management and streamlining the returns process in an effort of improving customer perception of the service altogether. As 50% of global e-commerce sales happen in marketplaces, there is a growing concern about brand building to ensure survival online. [17] Organizations compete not only based on price but across a large variety of services. The high number of products and brands in marketplaces attract customers but at the same time make it hard for brands to stand out. A well-adjusted and agile service is the best way to attract customers, for instance, accessibility and rapid delivery are critical determinants of success.

In this context, retention becomes a priority. It has been estimated that acquiring customers costs 6-7 times more than retaining them and typically delivers a variable ROI, then, prioritizing customer service support can have a big impact on a company's bottom line, as shown by a survey developed by salesforce:

Figure 5. Average percentage improvements reported by salesforce customers [20]

However, convince customers to purchase from a brand will become even more difficult and will drive companies to resort to new strategies and tools to make it happen. Bad service is a driver of churn, which is often the consequence of negative online shopping experiences that cause hassle and friction. One of the aggravating factors of churn is product returns as they impact customer

experience by forcing shoppers to endure a process with regret and often problematic, that ultimately produce the loss of their loyalty and the profit they bring. Therefore, companies are invested in maintaining clients and create loyalty, driving customer satisfaction from the point of efficiency and effectiveness of their pre- and post-purchase services.

Tech as an enabler

Technology is catching up to expectations. It's now smarter, more realistic, and affordable. Five years ago, the artificial intelligence and augmented reality that was needed to provide realistic mapping to the human face or body, just wasn't there. Many good teams tried and failed, mostly because market demand wasn't enough to fund their growth. Today, even knowing the adoption of technology is far from complete, some trends evolved to allow the spread of tools like AI and AR among all kinds of e-commerce platforms. The more relevant are M-Commerce and V-Commerce.

M-Commerce

One of the most noticeable trends in e-commerce is the exceptional usage of mobile devices. Just this year, mobile commerce is projected to generate about 55% of all e-commerce sales, [21] which is expected given that smartphones account for almost 70% of all retail website visits worldwide: [22]

Mobile	Desktop	Tablet
55.77%	41.5%	2.73%

Figure 6. Desktop vs Mobile vs Tablet market share worldwide - July 2021 [23]

Mobile is boosting e-commerce traffic. The fast expansion of mobile commerce has been pushed by several factors: The first is an improved wireless handheld device computing power, that allows customers to have every e-commerce solution at their fingertips, the second is the large number of new applications appearing every day that trigger the use of smartphones for their simplicity and agility, and finally the resolution of security issues that was a strong concern of customers and restricted the expansion of m-commerce. One example of the growth of m-commerce was witnessed during Black Friday 2020. The global statistics revealed that mobile generated 64% of visits while desktop generated 35%. Desktop still generated more sales (53%), but mobile wasn't far behind (47%), and orders were split 50-50 between mobile and desktop. [21]

Worldwide mobile retail revenue is expected to reach $3.57 trillion in 2021, up from $2.91 trillion in 2020. [13] As the embracing of mobile devices is progressing at a rapid pace, mainly in regions with the absence of other digital infrastructure, mobile assimilation will persist to shape the shopping experience of the customers in the future. M-commerce is particularly popular across Asia, with countries like South Korea where mobile traffic produces up to 65% of their total online transactions. It is also increasingly popular in the U.S since 125 million people own and use smartphones. [3]

As the demand for e-commerce continues to grow, so does the need for mobile experiences. For instance, 57% of customers won't recommend a business with a poorly designed website on

mobile. And if a website isn't mobile-friendly, 50% of customers will stop visiting it, even if they like the business. [13] This is important since most customers' buying decisions are influenced by the search of information they make through their smartphones. Consumers use mobile to research products they are considering buying and not just to make purchases.

However, even when websites are accessible from mobile devices, not all businesses are prepared to succeed at mobile commerce as their technological capabilities are still incipient or their budget has not allowed them to implement better solutions. For example, only 12% of consumers find mobile commerce convenient, (4x less than desktop), meaning there is significant room for improvement. [13]

V-Commerce

For the implementation of 3D and AR is necessary to introduce the concept of virtual commerce (V-commerce), defined as "not physically existing as such, but made by software to appear to do so" (Oxford dictionary, 2018). In line with this description, virtual commerce can be defined in a more specific way as "an electronically mediated commercial transaction that originates from an alternate reality technology platform and involves either digitally-generated or real-world products and services". [92]

The development of AR and 3D technologies announces a fundamental change from the internet of information towards the internet of experiences. For example, there will be cases where is possible to provide a near real-world equivalent through online shopping experiences. This is primarily because a virtual commerce interface, which, if properly designed with AR and other technological innovations, can support naturals shopping behavior by providing a more personalized, immersive, and interactive experience. The society and the new generations within, are ready to drive the following changes in v-commerce since they have practical intelligence, ability with technology, and tendencies to associate themselves with brands to express their identity. Brands can take advantage of this to increase engagement and trust.

The retailing industry is beginning to change due to virtual technologies affecting all phases of the retail environment. V-commerce will change the meaning of "what you see is what you get" since it provides consumers with the possibility to experience and explore different features of a product or service before the actual purchase, potentially creating the trust shortage that exists in people that never have or don't like making purchases in web-based environments. [92] Various companies are already trying different implementations and although currently, virtual commerce is still in the early adoption stage, it can be expected that in the future it will be implemented on a more global scale. For now, it is being used by companies as a new sales channel for brand building.

Some of the trends exposed have been taking form for many years now. Gattorna indicates that the most crucial point to begin from, particularly in the perspective of e-commerce companies, is the buying behavior of customers, concentrating on the delivery of goods. [24] Authors have stated that the experiential user interface and contextualization are the main points to develop

but technology have a long way ahead. User interface put immersion as the focus in achieving customer satisfaction through digital experiences, while contextualization covers the need of the customer to understand the characteristics of products and how they behave and adapt to their environment. It means the online market has taken a while adapting to the needs of the customers that keep looking for the best shopping experience. Fortunately, finally, technology is catching up to the task and will serve better the demands of the customers even if there is still ground to cover as many technologies are yet in development or early stages.

Chapter 2: Returns

The Chartered Institute of Logistics & Transport UK (2019) defines the functions of logistics with a model called the "7R's of logistics". These are: Getting the Right product, in the Right quantity, in the Right condition, at the Right place, at the Right time, to the Right customer, at the Right price. [25] When any of these conditions are not maintained, and there is an inconsistency arising during a commercial transaction, dissatisfaction among customers can be generated, and there is when most consumers may choose to return the product.

Product returns are very common. The Wall Street Journal reported that up to a third of all internet purchases are returned by customers, [1] with certain apparel businesses reporting up to 70%, [26] compared to 8.89% in brick-and-mortar stores. [27] Craig Adkins, Vice President of operations at Zappos, says their return rate is 35%, but with some of their customers, it can reach as much as 50%. [2]

The categories reported with the highest rates of product returns in 2019 are the following:

| 56% | 42% | 30% | 22% | 21% |
| Clothing/shoes | Electronics | Accessories/ watches/jewelry | Health and beauty | Movies, TV, music, games |

Figure 7. Percentage of returned items by category. [28]

This is consistent with the distribution reported in the Global Consumer Survey of 2021 made by Statista among leading countries like the U.S., where 25% of customers reported return clothing items, followed by shoes (15%), consumer electronics (10%), and accessories (8%), among the 44% of customers that agreed to have returned a product in the past 12 months. Also in European countries, like the U.K fashion items are the most returned products with 28% of customers returning in this category, 13% in shoes, 7% in consumer electronics, and 6% in accessories among the 45% of returners in the year. In some countries, "food and drinks" and "Household appliances"

categories scaled during the past year due to the new habits established during the restrictions of the pandemic. [3]
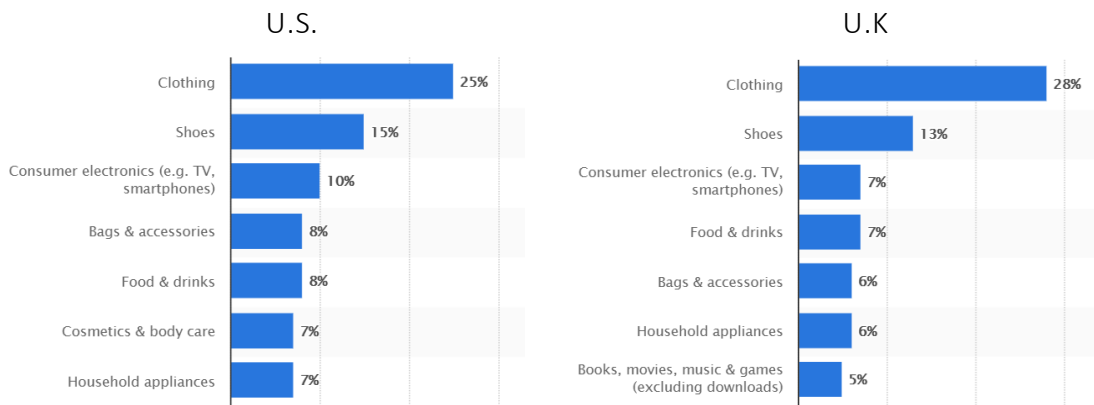

Figure 8. Main product returns categories U.S. vs U.K [3]

During 2020, millions of retailers started to depend on e-commerce as their sole channel for revenue. Increased adoption of e-commerce since COVID-19, brought more first-time shoppers than ever before, turning returns into the new normal and a central factor in customer experience. According to Narvar and Return Magic Survey, 41% of customers buy variations of a product with the intent of returning, 42% have returned an online purchase in the last six months, and 89% have returned an online purchase in the last 3 years. [30] Each time a buyer returns a product in the fashion category, the logistical cost escalates three times. [29]

Accepting product returns has become a great competitive strategy given the increasing market rivalry, and growing customer demands that follow this development. However, the nonstop returning of items has also proven to be very costly for retailers, as shown by a Harvard Business Review recent study. [29] Returns result in massive challenges for SCM, due to time, cost, manpower, and resources in general, causing a bottom-line blow, especially for companies like Amazon, that operate on very thin margins. This is usually amplified by bulky items that are expensive to ship, like furniture and some home appliances.

As The Reverse Logistics Association explains, managing "return and repair" activities is 10% of total supply chain costs, but if the supply chain overloads, due to inefficient processes, this percentage can grow, reducing profit by 30%. [30] This turn returns into a pain point, as evidenced by 44% of distribution center managers in an Intermec study. It also showed that 52% of distribution center managers cannot determine whether returned items should be sent to the vendor, moved into inventory, or discarded due to their lack of knowledge or resources, that's why products returned damaged, in a deficient state, or out of season, are frequently auctioned off to third parties ("jobbers") at very low prices, and is unknown to this moment what they do with these large quantities of different products. [31] In many cases it is due to the general lack of consistent data on returns. Any statistics they may have, are usually incomplete, fragmented, held by various departments, not consistently monitored, and not reported to senior management level, so companies are unable, or do not intend, to track products sold through various returns routes as it results in an expensive, cumbersome process that is not always worthy.

Is clear that customer returns are often viewed as an undesirable part of business, been related to losses and profitability issues. However, different authors revealed that a repeat customer who frequently returns goods generates more contribution per customer than non-returners. [24] The most profitable customers have approximately a ~32% return rate according to the company ReturnLogic. Zappos' VP of services and operations, Craig Adkins in an interview for Fast Company stated: "Our best customers, have the highest return rates, but they are also the ones that spend the most money with us and are our most profitable customers." According to the company, customers who purchase its most expensive footwear ultimately return ~50% of everything they buy. [30]

That is why there is a need to align Return Management (RM) within the supply chain strategy, where the entire supply chain operates efficiently and effectively, especially when talking about returns. Organizations have realized that successful execution of RM can provide several advantages as improved customer service, effective inventory management, and better product dispositioning. At the same time, it allows for all e-commerce companies to achieve their competitive goals, consequently improving their profits while benefiting customers and suppliers.

Return Management is an aspect to consider in the consumer experience since returns are considered an area of potential customer dissatisfaction. Companies need to find appropriate methods to exploit their knowledge to offer and deliver proper value propositions to their consumers in terms of RM. It should be aligned with consumer buying behaviors in the design of supply chain strategies that impact service delivery as well as for the sourcing of products in e-commerce.

However, there is also an opportunity to innovate and find new solutions for reducing product returns, improving returns systems, striving towards a more circular economy, and mostly, influence consumer behaviors to prevent returns instead of trying to improve return processes. [31]

Understanding the customer's mindset and their reaction to every product and situation continues to be one of the main challenges to return management and SCM. Companies can counter the impacts of unnecessary product ordering and return only by understanding the online product return behavior of their consumers, and so, serving as a vehicle for competitive advantage.

As e-commerce customers cannot touch and feel a product, to verify how well it matches their needs and tastes, they must rely on descriptions, photos, or poor representations that hinder making accurate decisions, with a potentially higher risk of dissatisfaction when they receive the product. The industry is mainly trying to solve this problem after the order is placed. Most of the existing literature develops around the forecast of returns with the only purpose to solve operational issues. [32] But if sellers can predict customer return probability in advance at a shopping cart page or during browsing, they could enable e-sellers to suggest alternatives with better chances or prevent such orders to happen. [32] It also could help to improve customer relationships, reduce return fraud, and abuse, and even enhance product and inventory management. [25]

Finding return probability for millions of customers at the cart page in real-time can be difficult, thus, even if there is not a way to avoid returns completely, awareness and action are key, and technology is making possible the adoption of this path.

Why are products returned?

According to the reference [25], the inconsistencies on products that lead to a return can be discomposed into two components, one for the buying phase (e.g., the product does not match the description) and another for the shipping phase (e.g., product damaged during shipping).

For the purposes of this study, which bases its goal on prevention, will be considered just the buying phase as the center of the argument. During the buying phase, consumers search for products that might meet their needs, forming a cognitive expectation. The "expected product" will, hopefully, match the actual product but, due to potential inaccuracy or misunderstanding of online product presentation, inconsistencies may arise. In this situation, a return is expected to be requested. [25]

Different studies coincide on the main reasons for returns in the buying phase. These are divided mainly into two groups, one is that expectations of the customer are not being met, which translates to products not matching the description or not fitting correctly. The other is related to the behavioral aspects due to impulsive decisions, like holidays returns or following returning trends as wardrobing or fitting room behavior. Both types were found to influence the frequency and quantity of returns.

In a study developed by the company Narvar, it can be seen in specific the main causes for returns globally during 2019, comparing Amazon and Non-Amazon merchants. It puts fitting problems as the main reason and description-match in the third position, especially for non-amazon customers (58%). "I didn't like it" and "I changed my mind" could be awarded to expectation problems, but also to behavioral reasons along with the last point (intent to return when purchasing). [33]
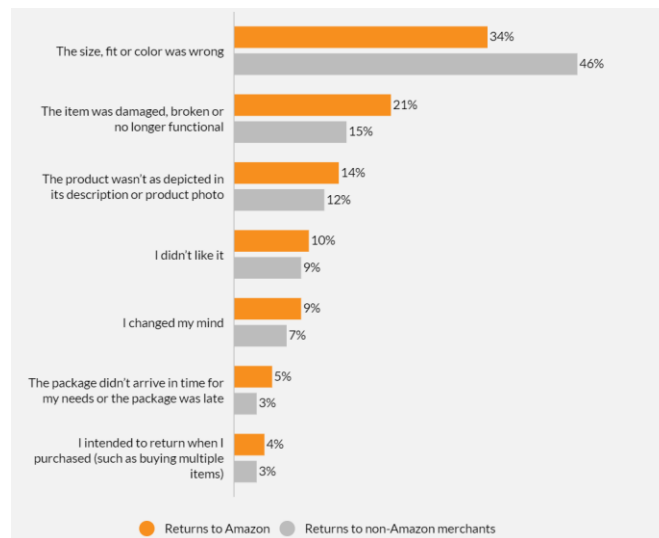

Figure 9. The State of Online Returns in 2019: A Global Study, Narvar [33]

Likewise, Return Magic surveyed 1,000 businesses in multiple industries and compiled data from over 800,000 Shopify customers to assess their operational performance against competitors. The study showed that consumer preference-based return reasons tend to drive around 72% of all returns in fashion product categories. [30] The main reasons are:
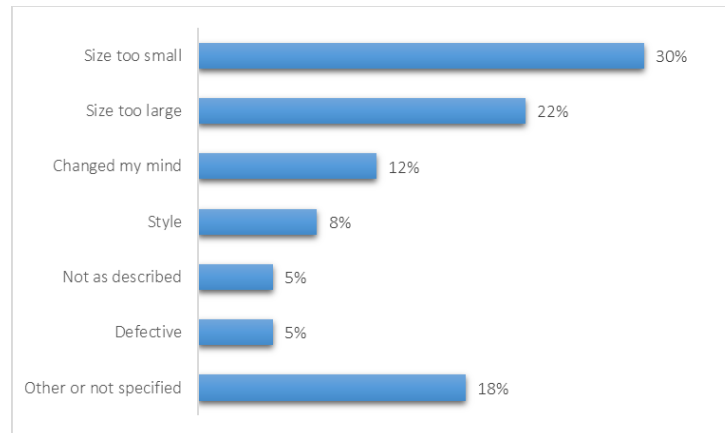

Figure 10. Reasons for returns in the fashion industry [30]

Many returns are in the hands of the customers instead of the provider, but it does not mean that is out of their control. These types of returns can be prevented by understanding the main issues generated by the problems mentioned above.

Fit - The sizing problem

Poor quality and erroneous shipping lead consumers to return products, but in product categories where non-digital characteristics are crucial, the most important cause of online returns is the lack of product fit. [34]

"Fit describes how well a product suits a consumer's preferences. For clothing, the fit may encompass size, cut, and shape; for shoes, it may refer to width, arch support, and flexibility; for hotels, it may include noise levels of rooms and proximity to resources, to name a few." [34]

For online purchases, fit presents some distinctive challenges related to information accuracy that has nothing to do with quality. Fit is difficult to evaluate prior to a purchase and can typically only be verified through physical inspection. Products that turn to be ill-fitting, may be of little use to consumers even if the quality is outstanding. Hong and Pavlou used a survey to measure the construct of product fit uncertainty and found that fit uncertainty has stronger positive effects on online product returns than quality uncertainty, thus it is considered a vital driver of the value of an item. [35]

The study developed by in reference [34] allows assessing the importance of fit information. They describe two types of product fit-related information that has an impact on online product return rate, the first one is fit valence, and the second is fit reference. Fit Valence can be defined as "True to size", or a customer subjective assessment of the fit of a product's attributes, for instance, in the case of apparel, a customer could classify an item as small, fit well, or oversized, regardless

the size given to the product by the brand. On the other hand, fit reference can be defined as "body size or dimension" information, being the customer description of the circumstances of evaluation of the product and the classification of their fit preferences, like their height and weight in case of clothes, or house dimensions in the case of furniture and appliances.

The study found that the presence of either of them by itself does not help reduce purchase errors, only by combining both fit-valence and fit-reference information is possible to drive the drop-in product return rates. The usage of these two characteristics may seem simple but is still a challenge for many brands. For instance, the online apparel industry is the most impacted in this matter, given that brands' multiple sizing variations cause substantially high return rates. Non-adopters or new customers are the most likely to order multiple sizes but also might hesitate to purchase products that could readily generate fit and size problems, such as shoes or certain non-flexible garments, which leads retailers to accept returns to counter the fear of losing customers.

As product sizing is turning to be one of the driving forces of dissatisfaction in the online shopping experience, customers are trying to deal with this problem on their own by replicating the in-store experience at home purchasing different sizes and colors of the same item, picking their favorite, and returning the rest, creating a phenomenon known as "The Fitting Roomer" behavior. According to ReturnLogic, some retailers in 2019 reached 20% of orders containing multiple product variants, especially new shoppers. [36]

Fitting roomers maximize the costs carried by the retailer. Some stores have decided to address this matter by limiting their service to frequent returners. In 2018, The Wall Street Journal reported that Amazon, as an extreme measure, begun to close the accounts of shoppers that made too many returns hopping to stop the trend of habitual fitting roomers. [37]
Understanding the exceptional challenge caused by fit uncertainty online, retailers are looking more and more for new solutions that provide useful fit information. The use of fit valence and fit reference could be the basis for different types of solutions that can be implemented to prevent the returns generated by the fit problem, which have so far been addressed only through product descriptions and photos. Some stores use reviews to present opinions on fitting while others employ sizing charts and instructions on how to relate them to dimensions in real life. These are a way to decrease return rates but still, there is a long way towards a complete solution that prevents the excessive usage of returns policies.

Expectations Problem

Another important reason for product returns is related to the behavioral aspect of the customer and is known as cognitive dissonance. It is a mental discomfort that results from a comparison between what was purchased and other possible alternatives. If this assessment puts the new product at a disadvantage against the others, it causes an emotionally uncomfortable state and general dissatisfaction with the product. [31]

As the unknown outcomes of forgone alternatives become important to the consumer as soon as the decision to purchase a product is made, the immediate time after a purchase is done represents the moment where products are most likely to be returned. This point is called the

"gamma" stage, and precedes satisfaction formation. [39] There are two dimensions of cognitive dissonance that customers can experience, product dissonance and emotional dissonance, both found to be related to product returns frequency. [38]

Product dissonances occur when buyers think about alternative products or outcomes (named counterfactual products) which are different from the actual product they already chose, leading them to believe that they have made a mistake, should have done things differently, or wish they had made different choices. [40]

This process where a consumer product experience does not fill their expectation about the purchase is known as disconfirmation and is where a return is more likely to happen. [39] When customers are exposed to disconfirming information, will often generate thoughts about better alternatives (upward counterfactuals) instead of downward comparisons that would make them feel better about their purchase. [31] This can lead customers to make a return of the product that goes commonly by the cause "expectations not met". [31] Approximately 22% of returns are due to the product specifications or appearance being different than what was promised on the website, which results in products not meeting the customer's expectations. [42]

On the other hand, emotional dissonance has been described as "a sense of disappointment or sadness due to the choice made with the possibility that the outcome would have been better if the customer had acted differently or waited longer". [43] As customers look for the best product, this realization causes feelings of regret, making them blame the store for the poor outcome while trying to reverse the effects of their decision by returning the product, or even avoiding a purchase before it happens if they think is possible to regret it later.

Different sources of literature indicate that emotional dissonance is an outcome or the result of product dissonance, thus, even if product dissonance does not impact directly return rates by itself, emotional dissonance does. [31] It is clear then, that regret coming from poor purchases drives customer behavior and is the key to counter unnecessary product returns.

The problem of Return Policies

Return policies are one of the most researched topics in terms of returns due to their impact on conversion and satisfaction, especially in e-commerce companies, since the customer is not able to see or touch the actual product. Return policies act as an assurance for the customer, making them confident and comfortable to make a purchase knowing that in certain valid cases it can be sent back.

According to the company UPS, approximately 62% of customers take the time to read the return policy before deciding whether purchase on a website, moreover, 40% of customers struggle to find the return policy, and 38% are dissatisfied with the clarity of the returns policy as it is not taken as an important issue for many e-commerce stores. These factors lead to distrust and dissatisfaction by the customer, leading ultimately to abandonment, as shown by UPS where 15% of consumers abandon the shopping cart due to unclarity in the return policy. [2]

These policies have large repercussions for how shoppers search, compare, order, and buy products online, hence, it is crucial to offer a fair, easy-to-find, clear returns policy that follows the trend towards easier returns in e-commerce and create a service differentiator that organizations can use as competitive advantage. It is an excellent option to retain revenues, but more and more companies are trying to beat the competition with a better service, giving into lax return policies that adjust to customers at the expense of companies' welfare.

From a positive perspective, liberal return policies are broadly employed to attract shoppers, especially when is implemented a "No questions ask" policy, as they can motivate consumers to purchase from online retailers and therefore can drive sales upwards. [29] These policies have been shown to positively influence customer experience and customer satisfaction, and hence, the purchase of related goods, which help to improve engagement and ultimately build customer loyalty. [25] Likewise, they have been linked to improved product evaluations as it signals product quality to customers, which influence a repeat buying behavior that increases sales that turn into profits. Unfortunately, this applies only if return rates do not rise significantly and overcome revenues, since relaxed return policies can also have an impact on returns rates by increasing the probability of returns and at the same time increasing the value of the items returned. [31]

Different return policies may be desirable for various customer segments. E-businesses usually offer multiple ways of returning products, often without charge. Increasingly, companies are changing the typical refund policy for alternatives that allow them to strengthen their relationship with their customer instead of just lose the sale. Among this can be found the exchange of products in case the customer requires a better fit or a different style, or the store credit in case the company is looking for a laxer policy that could lead to more expensive items.

For instance, the company Baseballism has adopted a policy where customers that decide to exchange instead of refund can pick the product they want and are granted an additional $5 of bonus credit if they intend to get something more expensive than what they initially bought. The new product will be sent as soon as the customer delivers the return to the carrier. This strategy allows them to keep more customers and sell more, while customers get their exchanged items faster, but sadly it also has increased the exchange rate to 53% as more than half of all returners are choosing to exchange for a new product. [44]

On the other hand, Amazon developed a strategy for their members called Prime Wardrobe, which limits returns to 3-8 items per order with a seven-day window to return before getting charged. [30] The initiative allows better control of returners and promotes sales, but at the same time incentivizes impulsive orders that should not be placed from the beginning.

Several brands continue to promote try-on-at-home programs with the purpose to bring an element of the in-store experience to the online customer. One example is the luxury footwear brand Inez, which allows buyers to purchase one pair of shoes but with the option of trying two different size variations and send back one of the pairs within 14 days at no extra charge. The program has been part of Inez's strategy since 2016, working very well to get ahead of returns related to product size and fit, and showing to be an appreciated feature for customers. [45] Despite this, it was demonstrated to be a significant and rising cost for them.

This shows that without correct management and control return policies can lead to considerable losses. With the promise of easy returns also comes an unavoidable high return rate, as the knowledge of liberal policies has been directly linked to increased levels of fraudulent returns. [46] It has a higher effect on companies that offer free returns as they can encourage reckless purchasing, thereby increasing the reverse logistics cost of the company.

One of the popular consequences of this is called wardrobing, which is a particular form of fraud where customers buy an item and uses it for a one-time purpose to return it as they may not be able to afford the item or are taking advantage of overly lenient policies. [47] With the rise of e-commerce, customers have succumbed to this type of practice that has spread to produce images for social media or to attend an event. It also has promoted impulsive and compulsive buying, as it is easy to reverse by returning the products.

For instance, in a survey developed by the company Yotpo, is shown how new generations are taking advantage of return policies. [48] Almost half of Millennials and Gen Z respondents have bought a product already knowing they were going to return it:

Millennials & Gen Z: Buying With the Intent to Return
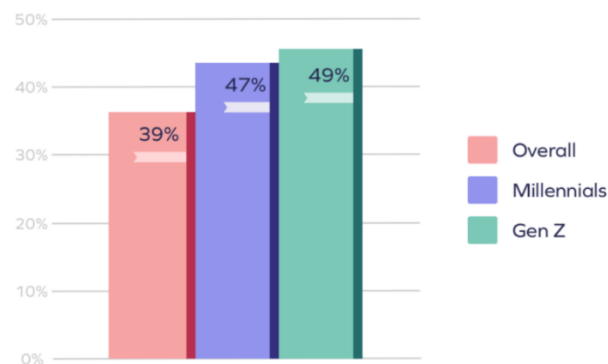
Figure 11. Percentage of customers buying with the intent to return by generation [48]

This behavior has forced some companies to implement a stricter returns policy or came back to a less lenient strategy for customers (e.g., no refund without a receipt). Some have taken even more drastic steps as the "habitual offender" list that several organizations have implemented to minimize the impact of these types of returns but have received bad publicity for it. For instance, ASOS and Amazon have blacklisted serial returners who do not keep enough of the ordered products, although it does not tackle the problem from the root. [26]

Other causes of returns

Different references identify some specific characteristics or situations that influence customer behavior towards product returns.

The first one is whether the product was purchased during the holiday season where is more likely that customers that receive products as a gift are inclined to return it than when they buy by themselves. On the other hand, as sales increase, the returns also increase. [49]

Another characteristic is whether the product was on sale, as e-commerce companies give discounts and offers for a few hours or days to attract customers to make online purchases, encouraging impulsive behavior that leads to high return rates. As before, is expected that the increase in sales by itself causes an increase in return rates. [38]

Lastly, if the product was in a new category or new channel for the customer is possible that return rates increase due to the time necessary for the customer to get used to the changes, or even to the dissatisfaction induced by this. [38]

Returns impact

Product returns are interdisciplinary in nature and hence a challenge for many industries, especially with the rapid growth of e-commerce. If they are not handled or controlled properly it will directly affect the company's brand value, earnings, supply chain, and customer service, often increasing expenses and inconveniences for customers, retailers, and manufacturers, and more important, causing irreversible environmental damage.

Concerning operations, retailers must gather and send the unwanted products back to the manufacturers, to be refurbished for resale, sold to a third party for residual value, or disposed alongside damaged items. [25] According to ReturnLogic, some of their retailers reported that almost 30% of products that came back in 2019 were not suitable for resale. In this case, the product by itself carries additional costs like the ones associated with damages, given the additional expenses necessary to scrap the product if the damage is irreversible and the product cannot be resold. In the case, the product is still useful, and it has a glitch or a bump, ReturnLogic stated that less than 50% of returned products can be resold at their full price, the product needs to be redone or refurbished while customers certainly will ask for a refund or a product replacement. In this scenario, the product can be sold again, but even then, it may need to be repackaged and remarketed, increasing its cost. [36]

To deal with this matter, companies have been forced to add workers to handle warehousing, shipping, and restocking; increase warehouse space for inventory; and establish separate departments to manage reverse logistics, consequently affecting supply chain management, efficiency, and cost. [30] The areas directly associated with product returns are shipping and handling, which depend on the operational processes of the retailer and therefore, increase the average product handling cost. E-tailers incur enormous losses linked to reverse logistics costs, liquidation costs due to damaged returns, fraudulent behavior, or even the call center increase on demand, absorbing a major share of the profit margin as shows Supply Chain Quarterly , which reports that processing a returned item can be 2 or 3 times as costly as processing it for fulfillment. [32]

When a product is returned to the seller it cannot be sold even at half of its price sometimes, [29] likewise, 20% of online retailers raise prices to compensate for the expense of e-commerce returns and many times consumers end up undertaking the cost of shipping and perceiving delays in receiving their desired product It is a major problem that affects deeply customer satisfaction and

loyalty. [50] It increases the probability of customer churn and if it is repeated, decreases profits and companies' brand image too. How an organization deal with returns before and after purchase can differentiate a brand and help create a competitive advantage that fosters value recovery. Recently, one way of doing it is through return management software used by retailers to power new insights to boost the shopper experience, brand perception, and efficiency in their operations.

Unfortunately, there is another aspect of product returns that has an impact beyond profits and reverberates over industries and communities equally. According to Vogue Business, only in the US returns created 5 billion pounds of landfill waste and 15 million tons of carbon emissions annually, equivalent to the amount of trash generated by 5 million people in a year. [26] Moreover, reports state that product returns produce enough emissions annually to power over half a million homes for a year.

The trend of product returns has pushed retailers to produce more than real demand, making them lose around 10% of their sales. Overproduction doubles the environmental cost, particularly in the apparel industry, as 84% of returned items end up in a landfill or incinerator. This increasing behavior has made 51% of customers consciously overbuy online, knowing they will return unwanted items. Each year it is globally generated almost 2,268 tons of waste derived from products that have not even been used. [36]

Apart from this, product returns lead to increased transportation and product waste, and it's not just the product that produces environmental damages, but the packaging that goes with it. Almost all the dispatched products have several layers of packaging regardless of whether it is plastic, cardboard, or fabric. Packaging waste is one of the most detrimental side-effects of e-commerce, generating tons of garbage and a huge carbon footprint that still not everyone addresses in their business.

Nevertheless, with shoppers more conscious about the environmental impacts of their shopping, companies are looking at ways to reduce this impact. There are some organizations committed to counter the effects of their practices. For instance, the firm Shopify, has implemented a tracking system for their transactions that calculates the carbon emissions for every order processed through Shop Pay. [44] On the other hand, there are companies working on packaging recycled or biodegradable materials as the brand Zara, who announced to be preparing to have 100% of the cardboard used in its shipments to be recycled. [51]

Although there is a slight improvement derived from numerous initiatives, this is far from being the solution. The most effective way to reduce the pollution caused by returns is to reduce them.

Chapter 3: Solutions

The current situation

Before entering the most innovative solutions, is important to highlight the traditional approaches to the prevention of returns, since are widely adopted and accepted by consumers and providers, contrary to the use of AI, AR, or any other. Different sources agree on three of the most popular and simple techniques that could be used to prevent returns and drive sales by delivering additional product information to customers:

High-quality product images

On the most basic scale, the traditional solution to prevent returns is to present products with high-quality images that are clear and detailed, since 75% of online shoppers rely on product photos when deciding on a potential purchase. [42]

This is still the most used way to present products. It is feasible and affordable, it does not require specialized resources, and it has the advantage to be shared easily. User-generated photography (especially from Instagram) combines compelling photography and social validation by showcasing products in real-life situations [52] but, in many cases, stores have a problem portraying their products correctly due to their lack of depth and context.

Pictures are followed by an accurate product description. It generally includes information about size or dimensions, materials, colors, instructions, etc. A popular practice in the apparel industry is to include size tables into the description, which are expected to help customers to find the right size for them by comparing the table to measures taken directly by the customer (usually around the chest, waist, and legs). Customers need as much information as possible about a product since images are not able to offer a complete understanding of it. However, customers usually are not willing to invest their time and effort in reading a long description or measuring themselves while deciphering a chart. It could happen as well that photos and descriptions are not clear enough about the features of the product in a specific context or they are not enough to engage customers. All of this creates uncertainty, that leads the customer to returns the product or abandons the purchase.

Video

Using product videos on e-commerce sites can increase sales and product understanding. When done right, product videos tell an engaging story that helps the company to educate, entertain and inform customers, encouraging them to make a purchase. [8] Moreover, videos help buyers to understand the brand's offerings and build trust with prospective clients since are highly shareable via social media.

Many businesses opt for branded custom video content, since watching a video helps customers decide to purchase a product. Moreover, videos are commonly used by companies since they have been proven to build more confidence in customers. [13] This makes them a good alternative to

deal with returns. As customers had a better view of the product and what they can expect, is more likely that they are sure of their choice, and hence, keep the product.

Some companies have recently adopted different video strategies called "Video Shopping", to simulate a showroom or speed up the regular process of purchase of a customer. One of the most popular consists of a video with 360-degree rotations of the products to exhibit them better. Other is live streaming, where someone is in charge to expose the product and mention its characteristics and price to achieve a quick sale taking advantage of social media and the rush generated by the live video. [53]

Reviews

Reviews are one of the most popular strategies used by companies to understand customer needs and satisfaction with the brand. It also gives insight into the type of information customers want to know about the products. The reviews play an important role in the customer's decision. For example, Shopify found that 70% of customers check reviews or ratings before making their final purchase since they signal that the brand is reliable, knowledgeable, and attractive to future customers. [47]

Reviews often show as a solution to understand the size and fit of products, but this kind of data proved to be not meaningful and divergent, while the data for quality attributes tend to agree on what is good versus poor. Some companies have implemented a fit-related product review function to quantify the fit rates of customers and use it as a guide for other customers, but it relies on customer perception making it still vague. For example, Zappos.com and Nordstrom.com request their customers to rate the item's fit on a 5-point scale from runs small (narrow) to runs large (wide) in addition to the overall usual rating of the product. [34]

Reviews were implemented to help customers in their purchase decision through comments related to quality, fit, performance, and even taste, making them a general strategy to prevent returns. The work in [54] evaluates the impact of online product reviews on product returns, by fusing multi-source information including product characteristics, product reviews, customer characteristics, customer activities, and so on. However, this tool does not solve the problem nor offer an alternative, while bad reviews are only creating harm to the image of the company.

Brands can reduce e-commerce returns by providing clear product photos and descriptions, encouraging customer reviews, and evaluating the collected data. Yet, reviews will always be part of the tools used to assess a company's operation and can be a point of reference for customers, but they cannot offer all the information they require. To mitigate the unique challenges posed by fit uncertainty and misleading expectations, online retailers have started to implement a variety of solutions that will be explained in the following sections.

Fit Assistant

One of the most affected sectors in e-commerce with product returns is the apparel industry, with returns rates that can reach immeasurable rates. As sales keep rising online, it is particularly important for them to find a feasible solution to one of the main causes of returns: the fit problem,

which is why different companies have developed new strategies to bring the customer closer to their ideal product through technology. One of the most feasible solutions to this is called fit assistant.
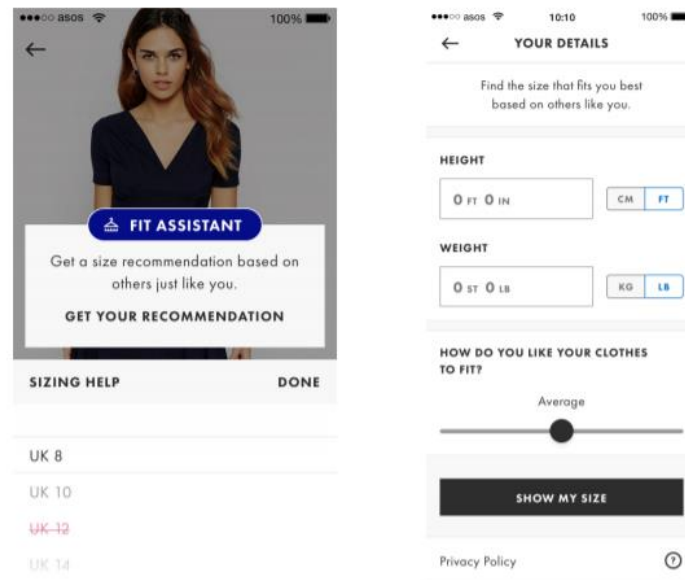
Data-Driven System

Figure 12. Example fit assistant

Some years ago, the way to assist customers in finding the correct size was by providing size conversion charts that translate the body measurements into the product sizes. It led to inconveniences like putting the customer in the task of getting their own dimensions, which even with the help of tailor-like tutorials tend to mislead the correct size and fit due to the high variance of these charts even if the clothes are from the same brand, or to errors coming from the customer.

The previous issues make it essential for fashion e-commerce to introduce the help of a ''fit assistant'' that personalize the size and fit recommendations by asking users for their age, height, and weight among other measures, together with some pictures (in certain cases) to determine the body shape and give the best size as final output. This tool is basically a traditional collaborative filtering algorithm that seeks to model customer preferences based on their previous orders. Nevertheless, a challenge for this model is the extreme sparsity of products purchased by custom and category, thus, to overcome this problem a wide range of deep learning-based content-collaborative methodologies had been developed to personalized size and fit-based on new machine learning technologies.

The literature suggests different customized models personalize the size and fit, but only some of the most popular are going to be addressed below:

The reference [56] explains the first one, which introduces the development of a "skip-gram based word2vec model" on the purchase history data of the customer, used to learn representations of products. This approach then creates a customer profile by aggregating the learned representations of the articles previously purchased by the customer. Following, a gradient boosted classifier is then trained based on the product's latent representations associated with the customer to predict the fit.

In the reference [57], the authors introduce a hierarchical Bayesian approach for personalized size recommendations. This model relies on customer and product pairs, for which is modeled the joint conditional probability of the size ordered by a customer together with the outcome of said order, for example, the size of a product when is kept vs. when is returned. Moreover, for making personalized size recommendations, the method uses the conditional probability of size, given a particular customer and product, with the outcome set to keep. The method uses approximate probabilistic inference for parameter optimization and testing.

Secondly, the reference [58] proposes a method to deduce the 'true' sizes of customers and articles using a latent factor model that utilize data from purchases and returns. The feature needed to deduce the size is integrated into a basic classification system to perform a fit prediction, for example: small, fit, or large. Additionally, the method performs hierarchical clustering on individual customer data to handle those cases where multiple customers are behind one account.

Another methodology is proposed in the reference [59], which models the size recommendation problem as a fit prediction problem. In a two-step procedure, the model first uses an ordinal regression to embed customers and products in a latent space with the same dimensionality. Once the embeddings are obtained, they are used in the next step to learn representations of products for each category by applying prototyping and metric learning techniques.

Most of the works mentioned above do not take an end-to-end approach. While some models are limited by w.r.t. scalability due to their probabilistic nature, others will be limited by the capacity of the system as is constrained by predefined interactions, linearity assumptions, ability to handle cold-starts, or model multiple users behind one identity. On the contrary, other approaches represent a scalable, end-to-end deep learning approach to size and fit recommendation.

All the available models that have been designed to fulfill the goal of size and fit prediction, deliver good results, but it is still a work in progress to determine which are an optimal solution to ill-fitting products. For the time being, each one has been proved beneficial in contradistinction to traditional approaches and is deserving of further implementation, as predicting the correct fit drives customer satisfaction and helps the business by reducing costs incurred due to size-related returns.

3D scanning and machine learning
Customer elicitations not always can be achieved with this wide range of analytics algorithm-driven interfaces based on body shape and given information. Some customers have multiple

preferences in how thigh or lose the product should be, how the material fit, or even how the style of the clothing will look on them. Thus, include this new parameter in the process of recommendation could lead to an increase of the customer confidence in a purchase, and its satisfaction after it, which consequently reduces return rates. Currently, one important way to tackle this matter and popularize online apparel shopping is through 3D scanning and machine learning systems.

Customers want to know how the clothes fit on them, how it looks and how it feels. Digital try-on systems are expected to satisfy these needs, providing visual impressions and customized clothes sizing as well, which makes this method an alternative way to drive online fashion shopping to prevent returns due to size and fit and improve user experience.

Currently, there is some work and development to be done to replace physical try-on with an easy-to-use online solution. There is a substantial technological gap between digital modeling and real-world clothing fitting demonstrations that include a fast and realistic demonstration of products, accurate modeling of clothing material, and effective transformation of clothes between virtual and physical worlds.

As commented in the reference [55], digital try-on systems development can be described based on the following representative estimations and designs:

1. *Human Shape Estimation*

   Accurate human shape estimation is key to enabling digital try-ons. Human body reconstruction, consisting of pose and shape estimation, has been widely studied through various tools like virtual and augmented environments or direct 3D body scanning, which can provide excellent and accurate results. One of the most useful tools is RGB images (red, green, blue spectrum) which are widely available for input in digital try-ons and can be easily captured using commodity mobile devices. However, body scanning adoption is somewhat limited by the required specialized hardware needed for the data processing of the images collected.

(a) Input image   (b) Recovered body

Figure 13. Human shape model [61]

2. Clothing material modeling

Clothes material plays an important role in digital try-on systems. Recreation of the physical properties of the fabric not only gives a visual simulation of clothes but also affects how the clothing feels and fits on the body. Hence, the clothing material modeling problem must be developed with enough data to imitate the material's physical behavior and properties, so that visual effects reproduced by a computer are the same or closely similar as those of the real material. This has two implications: firstly, is necessary to define a model for the material, and second, is necessary to estimate within the model the parameters of the material.

3. Clothing model and design

Realistic apparel model generation has become increasingly popular, due to the growing need for clothing prototypes in different applications such as virtual try-ons. Their design requires to have a general cloth digital model that can represent a diverse set of clothing. However, there are many challenges in automatic garment model generation. Firstly, clothes usually have different typologies, especially for fashion outfits, which makes it difficult to design a universal digital model. Moreover, it is often not easy for general clothes designs to be retargeted onto another body shape, making customization difficult. Thus, a learning-based parametric generative model is introduced to overcome the above difficulties, given clothing sewing patterns and human body shapes as input.

There are remaining open challenges before online try-on systems can be widely adopted and replace physical try-ons mostly owing to the difference between the modeling of products versus the real demonstrations of garment fitting. Yet, 3D scanning, and machine learning have excellent potential and are rapidly developing to reduce the gap through the methods previously explained.

The reference [60] is an example of the implementation of one type of 3D scanning and machine learning that is currently on the market offering easy access to customers and a personalized experience. The following is a scheme that simplifies the process:
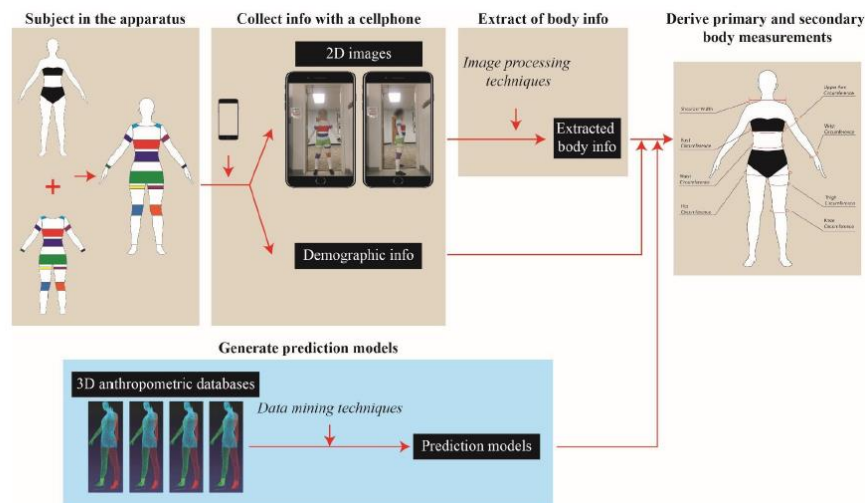

Figure 14. 3D Scanning process [60]

In this example, the researcher focuses on the creation of a fast-personal garment apparatus, system, and method for measuring body dimensions extracted from two-dimensional images taken by a consumer. Measurements of the individual are taken from captured pictures or photographs from their smartphones while wearing one or more coded dimensioning garments that have markings at specific locations that can be aligned with characteristic body features and key measurement areas. Computer vision is used to track these markings and extract key body dimensions. A machine learning software application is incorporated so object detection can be used to recognize colors and patterns on the garment allowing the clothing to act as a measurement device for the body.

Case study: Easysize

Easysize is a company that helps fashion brands to increase sales and sustainability while lowering online returns through a data-driven system that can be suited for fashion brands, marketplaces, or multi-brand shops. Here are some examples of their results that can be linked to the reference [67]:

Labfresh & Easysize:

LABFRESH started as a Kickstarter project in January 2017, the brand developed the idea of men's shirts that do not need to spend so much time in washing and ironing with the purpose of stop overconsumption and reduce waste. Easysize started to collaborate with LABFRESH in July 2020 through a solution that helps and engages first-time shoppers to find the right size. The designed solution was called ''Fit Quiz'' and consisted of a few questions about the most common size they use, the shape of their body, and the fit they usually wear, which take the customer around 15 to 20 seconds to fill in total. It was done to be easy to use and does not distract shoppers. Moreover, the data-driven system was created without the need of taking any measure or perform any other time-consuming action. The recommendation is also personalized for each SKU individually, which means that different styles and fit preferences are taken into consideration.

Once the recommendation was done, and a user has purchased and received it, then the customer is reaching out with a request for feedback. That not only helps to improve the user's future recommendations but also updates the weights of the parameters in the algorithm. That closes the loop and allows the company to accompany the user on every step of the experience.

By using the data-driven system the firm was able to provide tailored size recommendations to the customers, and therefore, increase its sales conversion. Shoppers are 4.5 times more likely to purchase an item when using the ''fit Quiz''. Customers are more confident, especially when they are new to the brand, hence, returns that were size-related decreased by 22%. In terms of the company revenue, for every 1 euro invested in the data-driven system, 21 euros were generated through the increase in sales and decrease in clothing returns.

Ami Paris & Easysize:

The company was founded in 2011 by a Parisian designer and offers a broad wardrobe with stylish clothes. It counts with more than 300 points of sale but launched an online shop as part of their international expansion, joining the e-commerce industry. Easysize joins to the project in 2016 to

reduce their high return rates by providing the right size recommendations through a customized data-driven system.

By adopting the Easysize solution, AMI was able to lower its return rate by 44% in orders when the system was used. Moreover, company reports showed that approximately 7% of returns were prevented overtime after the implementation, and 200% in ROI was attained. These returns rates had been stable in time.
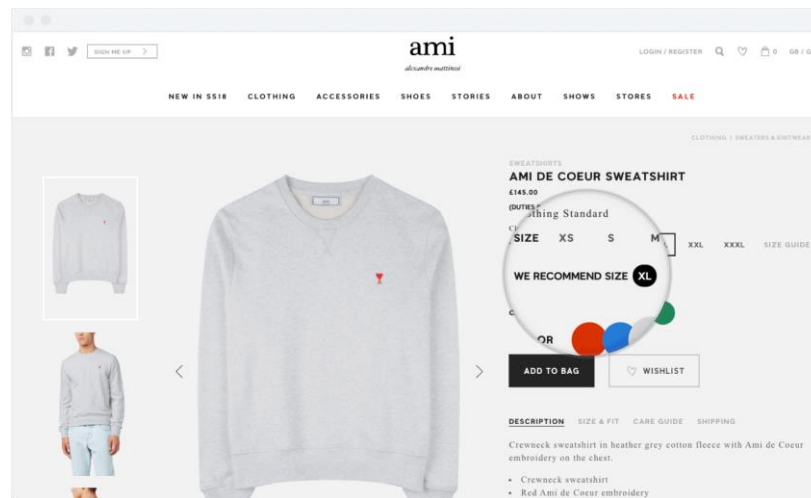

Figure 15. Ami Paris fit assistant

Veepee & Easysize:

Founded in 2001 Veepee is one of the only e-commerce unicorns in France that pioneered the model of online flash sales. Their website is private to its 70 million members worldwide. Sales are for a limited time only (3 to 5 days) and are organized in close collaboration with over 7000 major international brands in all product categories.

Veepee's members have access to exclusive deals from thousands of international fashion brands. Sizes often vary between brands leaving shoppers with a challenge to find the right one and do it while a sale is still active. This all leads to uncertainty among shoppers, hence, some of them end up buying the wrong size, and some will buy several sizes of the same item to try it at home.

To decrease the number of size-related returns and boost user confidence Easysize join to Veepee in 2017 on the French market. Easysize's approach to solving the sizing issue is focused on analyzing shoppers' previous acquisitions and return history – to better understand their individual style and fit preferences. In the case of Veepee where sales are campaigns that run for a limited time, it was crucial to provide the right recommendation for every stock-keeping unit, every customer, and every campaign.

The solution was a data-driven system that does not use any size charts or measurements. Instead, it considers acquisitions and returns from shops and thus can instantly scale its recommendations to all brands sold on the website. One of the biggest differentiators of this data-driven system from other sizing solutions is the continuous user experience. The system doesn't require any inputs from shoppers and auto-recommends the right size to all regular shoppers. It allows

businesses to engage with a significant number of orders and have a notable positive impact on Veepee's overall key metrics.

By auto-recommending the size to customers, Veepee was able to lower its return rate by 14%, even when the system was used only in 22% of all purchases. In addition, when the recommended size was shown, the sales conversion increased by 35%.
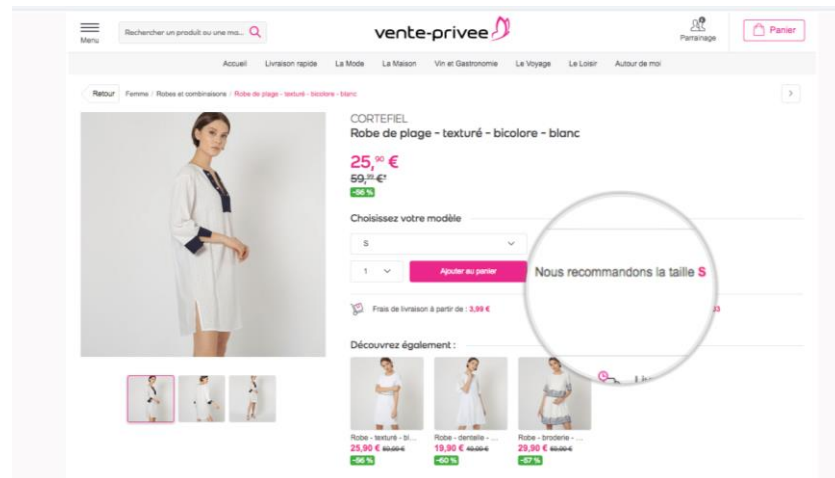

Figure 16. Veepee fit assistant

Modomoto & Easysize:

The company is a worldwide top player in the market of stylist-assisted online shopping and serves customers across 8 countries in Europe. The group uses stylists to creates individually chosen selections of fashion for each client. Sizes often vary between brands and customers' fit inclination may vary between categories, leaving stylists with a challenge to find the right size for each one, and as a result, stylists end up making some mistakes and the keep rate of orders suffer, as customers return items that didn't fit them.

Easysize was integrated into Modomoto as an internal styling tool in 2018. The data-driven system analyzed the record of kept and rejected purchases to better understand customers' individual style and fit preferences. Based on this analysis and a small questionnaire, the system was able to find the right size and fit for each category, brand, and item. The model also addressed the problem of "country sizes" through different sizing formats and systems for each one. For example, United Kingdom sizes come in formats 8-10-12, while European sizes are in formats 38-40-42, which was vital given that the company has customers in a few countries.

The key was to offer the right suggestion for every user on a per-stock-keeping unit basis, given the kind of service offered. The data system was able to deliver real-time suggestions to stylists without affecting their process. These suggestions were used in 19% of all orders where the company was able to lower its size-related returns by 29%, and additionally, increase the overall keeping rate by 9%.

Case study: Zalando

Founded in 2008, Zalando is Europe's leading online fashion platform and connects customers, brands, and partners. To compete in the market, Zalando has adapted to the needs of customers with the help of new technologies. The company is working right now in the implementation of their own data-driven system call ''size & fit'' program, intending to improve return costs and decrease CO_2 emissions.

Zalando has identified the new elicitations of the customers and the new reality that the recent years brought to the e-commerce industry, which can be seen through the projects developed by the sizing team of the company. In the search of stand out in the market from other companies like ASOS, pioneer of the data-driven systems, Zalando bought FISION AG, a Swiss startup that developed ''Meepl'', a 3D body data platform enabling scalable made-to-measure, size recommendation and 3D virtual dressing room services for fashion e-commerce. With Meepl, anyone with a smartphone can create a 3D avatar and a list of more than 150 measurements within just seconds. With the user's body data at the core, Meepl helps brands & retailers to reduce return rates, digitize supply chains, and delivers a completely new, interactive, and personalized 3D online shopping experience. Meepl's vision is to improve the sustainability of fashion by reducing the 30 percent of clothing that gets returned or ends up in a landfill. [68]
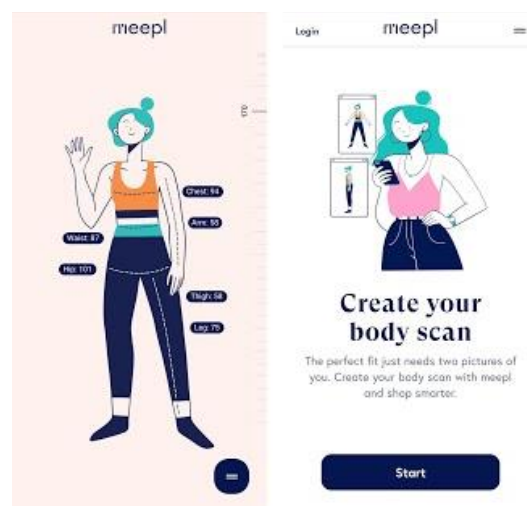
Figure 17. Meepl platform by Zalando

They had tested three different ways of generating body measurements. One was with facial recognition with no 3D component, just 2D images. Then two-dimensional image processing was tested which represents a computer vision of full-body images and as final trial big scanning machine. The tests were compared to measures obtained by a professional tailer and the results were promising. In the case of facial recognition, the measurements were around 84% accurate and with the two-dimensional, full-body images the results were 97% accurate. [68]

Zalando represents an example of how the application of new technologies can bring multiple benefits for the company and the customers, showing how ready they are to improve their service. They have identified that now more than ever the tools to tackle the size and fit challenges are

still in early stages, but possible futures stages are those created with the base at 3D scanning and machine learning technologies. So, that is certainly a forthcoming solution that will create opportunities to improve and personalize the user experience while preventing product returns.

Artificial Intelligence to predict returns

Some years ago, tools to address returns problems suffer from the lack of technology of the time. In the reference [64] can be seen a way in which the problem is approached in a more simple and unsophisticated way including the use of the proportion of returns on sales with a known life cycle length. Other documents like the reference [63] show an approach for a statistical model of the autoregressive type to forecast returns quantity and time. Both methods estimate the total return quantity within a period but cannot predict individual customer's return actions. However, with the past of time and improvement of the available technology, in the document [62] is described an investigation for return rate prediction based on product features, customer attributes, and basket information.

The use of artificial intelligence and machine learning has opened a new opportunity to approach the problem of returns through multiple strategies as the following:

Before order placement

One inventive strategy in the path to fight product returns is the predictions of them before the order is done. Artificial intelligence allows real-time assessment of the client's basket correlating it with the client's individual profile, which includes preferences, purchase history, fit, and order value. All to predict the likelihood of return of the products in the basket. The system can detect the number of similar items in the cart and if the items are of the right fit (in the case of clothes), thanks to information gathered from the customer's past return rate for similar items

This information is collected and processed through an artificial intelligence decision-science engine that can prevent possible returns through the implementation of suggestions to the customer. These recommendations include offering a targeted promotion, suggesting better-suited substitutes, free delivery charges for a different product, or even dissuading serial returners from making the purchase. For instance, it may increase shipping charges as a disincentive, or offer a voucher as an incentive in payback for making the purchase non-returnable.

After order placement

Artificial intelligence (AI) has the capacity to develop a contextual assessment with the data of sent orders, purchase history, customer profile, social media trends, and product performance from historical data. This contextual assessment creates a forecast return system to help vendors to plan a reverse-logistic scheme that helps to reduce the extra costs caused by returns and in addition helps to identify and manage those customers who abuse the return policy.

Other business areas

The use of AI can be linked to other business areas to create opportunities and bring efficiency across the value chain. From the sourcing point of view, through artificial intelligence is possible to correlate suppliers to product return rates in order to ensure the right product at the right price in the future. Moreover, in marketing is feasible to enable AI technology to customize targeted advertising based on customer returns profile. In addition, the supply chain and logistics department of the companies can benefit from these innovations to prevent inbound returns for better store and resource management.

Eliminate reasons

Through the integration of an assessment of returns with internal and external data sources, AI can help vendors to understand customers better. This data can be used to ensure that the potential clients buy with confidence and so, key reasons for returns are mitigated. As commented before in this document one example of this kind of implementation is the "fit assistant" in the apparel industry, used when fit and size are a deal-breaker in returns. Another AI integration is through personalized recommendations, used by fashion and sports brands to provide customers with customized suggestions when shopping online. Also, the AI can be used to predict price points with tools like "TCS' Optumera", which apply real-time computational intelligence to track and forecast competitor's prices, variety, and inventory across channels to enable retailers to create winning competitive strategies that reduce returns. [81]

Case study: LoGraph

The document [65] proposes a "random-walk-based" local algorithm named "LoGraph", to find the cluster consisting of ranked customers centered around the core of the analysis corresponding to the target product.

The computational complexity of "LoGraph" depends on the size of the output cluster, rather than the entire "graph" (a mapping of the entire set of data from many domains), making it particularly suitable for learning from a large-scale data set consisting of historical purchase and return records. The performance of "LoGraph" is evaluated on multiple e-commerce data sets, showing that it outperforms state-of-the-art techniques.

The main contributions of this algorithm can be summarized as the recursive way in which the system uses a novel weighted hybrid graph "HyGraph" to represent rich information in historical records, to model customer purchase and return behaviors in e-commerce. Moreover, the algorithm "LoGraph" customized for "HyGraph" identifies customers who are most likely to return with respect to a specific product. The research uses real-world data sets from leading omnichannel retailers to validate the performance of the proposed graph model and local algorithm, which demonstrate their effectiveness and efficiency.

Case study: Matrix Factorization

As a second case study, the paper [66] proposes a novel deep neural network-based approach to predict a customer's likelihood of return even before an order is placed. To get users' taste and

products' latent hidden features, a Matrix Factorization (MF) based on a BPR model is used to detect similar products in a cart. This is an exhibit in the fashion industry, where customers purchase the same product in different sizes trying to solve size & fit issues. To capture this in the model, the developers have created a user's sizing vector using a skip-gram-based model. In the network, the designers have used both these vectors along with engineered features. A hybrid dual-model approach is proposed to first, predict the return probability at the cart level, and second, predict at an individual product level. Prediction happens in real-time at the cart page, so that preventive actions can be taken based on the return probability value. The possible set of actions were:

- "Personalized Shipping charges
- Make product non-returnable by giving an additional coupon
- Try & Buy options
- In case of return related refund, money goes directly to a wallet which can only be used for shopping again on the same platform
- Restricting payment options like Cash on delivery
- Advance alert for reverse logistics
- Artificially show the product as out of stock & prevent the user from placing that order"

Most of these action items require the return prediction at a cart level whereas for the rest it should be at an individual product level. The proposed hybrid dual model serves both scenarios.
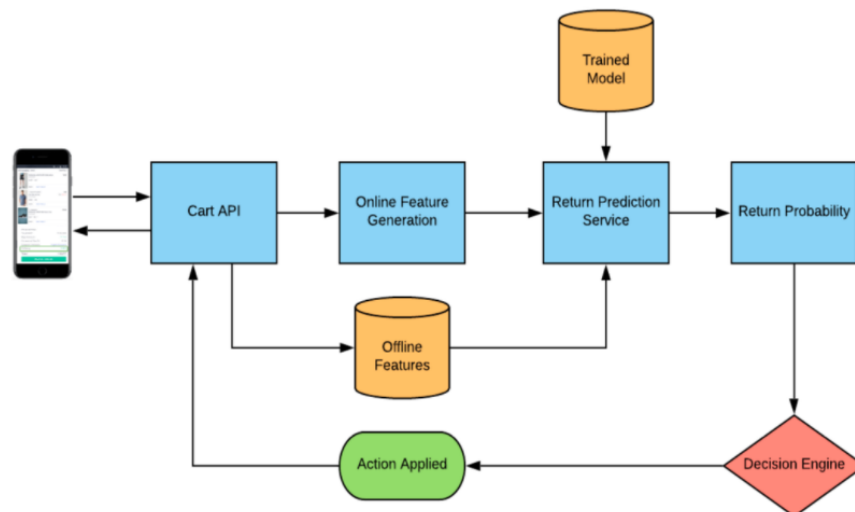
Figure 18. Real-time production architecture [66]

A "real-time production architecture" assesses shopping carts in less than 70 milliseconds and decides whether to issue rewards or punishments to curb expected returns behavior. [66]

An important approach was performed in the document with the live experiments performed on one of the leading fashion platforms. Experiments were conducted on three action items named before. The first experiment comprises the application of personalized delivery fee, different for all customers depending on their respective live cart. The dual model first predicts the return

probability for a cart and then uses this in a gradient boosted approach to identify the exact number of products that will be returned from that cart. The conclusion derived from this experiment was that even though the number of orders reduced by 1.7% in the test set as compared to the control set, the return percentage dropped even by a higher number (3%). Further analysis indicated that 90% of churned users had a high probability of return.

The second experiment was to make the product non-returnable by providing an additional coupon. The product-level model gave the return probability of each individual product in the cart. When this probability was high, it decided to offer a small push of additional coupons and make that product non-returnable. This compensates for the reverse logistics or possible damage costs. The result showed that 27% of the users applied this option in the cart and marked 1.5 products (on average) in their cart as non-returnable. This reduced the return rate in the test set by 4% as compared to the control set.

In the third experiment, a Try & Buy test was conducted where the users could try out their purchases at the time of delivery, keep what they like, and return the rest on the spot. The hypothesis behind conducting this experiment was that it will reduce the reverse logistics cost incurred during a return. Adoption of the try & buy feature was 40% which reduced the return rate in the test set by 3.7% as compared to the control set. However, it is far more difficult to implement than other strategies as it requires user involvement in the process.

Augmented Reality

AR is defined as "the superposition of virtual objects (computer-generated images, texts, sounds, etc.) on the real environment of the user". [69] Its most important feature, that makes it different from the existing forms of VR (Virtual reality), is the ability to create a "mixed reality" in which the surrounding environment is real, but the objects portrayed in the environment are not. Besides this, is known to be "interactive in real-time" and "registered in 3-D". [70]

The functional mechanism of AR is composed of two main characteristics, interactivity, and vividness. Both with the power to influence consumer purchase intentions.

According to reference [71], interactivity can be understood either as a technological outcome and as a user perception. In terms of technology, it is the ability employed to allow users to more easily interact and be involved with the content. It defines 3 characteristics of interactivity: speed, mapping, and range. Speed refers to how fast content in the environment can be manipulated; mapping is how similar is the control used in the environment with the real one; the range is defined as how broadly the content can be manipulated in the environment. For instance, a user of a videogame that faces a lagged response will sense a low level of interactivity because the feedback from the medium is delayed.

Interactivity as a user perception involves the individual attributes or traits that induce in the user the feeling of interactivity. [72] The user's subjective perception of interactivity depends on the effective delivery of the technology, which enhances and motivates the user to participate.

Reference [71] also describes the second characteristic for AR to work: Vividness. It refers to "the ability of a technology to produce a rich sensorial mediated environment" combining "the sensory experience of actual objects" with the "non-sensory experience of imaginary objects". Vividness can be enhanced by depth, defined as the perception of the users of the quality of the represented information, and breadth, defined as the number of sensory dimensions the medium can deliver.

In the context of e-commerce, vividness is often described as the quality of product presentations. A more vivid portrayal of products is expected to stimulate the consumers' cognitive elaboration processes. Likewise, vividness helps consumers to foresee (in their mind) experiences with products in future situations, which results in the reinforcement of confidence for a purchase decision, and longer memory about relevant information. [71]

The result of the functional characteristics of AR can be assessed through the sense of immersion produced by the user. In terms of e-commerce, immersion can give the user a state of deep involvement or engagement in the task, called "para-authentic" experiences, [73] which are described as a perception of experiencing virtual products as real products. It has been shown that representations of products through AR drive users to have para-authentic product experiences, and even more, these were found to facilitate consumer evaluations on products. Product representations through AR normally end up having much higher values in evaluations than consumers using the regular web-based experience.

On the other hand, when customers acknowledge possible technological constraints like slow responses (low interactivity) or poor quality of graphics (low vividness) during AR experiences, the sense of immersion may be reduced if not eliminated. [74] It could also be affected negatively if users were previously invested in AR experiences many times, meaning higher immersion for new users.

Forms of AR

According to ARtillery Intelligence, AR is relatively new but there are a few areas that "stand out for their monetization potential and business case". Lately, many companies have started to consider and recognize the huge capability of one of them called Immersive shopping or Camara commerce, known for a huge revenue impact on brands and an even greater experiential impact for consumers apart from the usual use as a tool to see and contextualize products for further informed purchases. [75]

One of the principal sources of revenue for AR is commerce enablement and in-app purchases and advertising, which suggest that AR will play a role in some part of the consideration funnel for transactions. Therefore, is not a surprise that in March 2021 Facebook announced that a full 20% of its workforce is now dedicated to AR & VR development. This is supported by the high

satisfaction reported with mobile AR (75%) but contrasts with non-users, who report a low likelihood of adoption and explicit disinterest. [76]

The following graphic shows some of the forms of immersive shopping and their potential impact on sales of physical goods in the US along:

Figure 19. AR Visualization-influenced purchases by platform from 2019 to 2024 [75]

Altogether AR purchase products are close to 4900 million dollars, which is more than double compared to 2020 where covid restrictions boosted the use of technological means in retail. It is expected to continue this growing behavior next year reaching almost 36000 million in 2024, meaning a growth rate close to 87% in less than 4 years.

Product visualization

Among the formats exposed previously, product visualization has been the one with the most development and traction until now. There is a growing interest in it given the support that brings to e-commerce transactions by letting users visualize products on their own space to see if they fit or adapt to their needs and tastes. [75] For instance, some apps allow shoppers to visualize items in their homes, which can then be purchased from their mobile devices in no time. When the visualization occurs directly on the user, is known as Virtual try-on, which allows the user's body parts and virtual objects (target products) to reside simultaneously. This kind of AR is linked to the apparel industry. [71]

The best choice for firms where fit is crucial is try-on technology, like in the case of stores selling clothing. However, it does not stop there. Carat Lane, one of India's largest online jewelry retailers, implemented this technology to introduce the world's first virtual 3D jewelry try-on app, employing facial recognition and three-dimensional imaging technology to turn the user's laptop or smartphone screen into a mirror. Another example is the IKEA place app, which lets users experience how true-to-scale furniture would look, and fit, in their house.

Product visualization got plenty of attention during the pandemic as it adds value and dimension to e-commerce. It is expected to go from 2.13 billion last year to 30.2 billion by 2024, [75] meaning

a huge opportunity to ground and spread the technology to non-users of AR that account, at the moment, for 71% of online adults in the US. [77]

The development of product visualization has been more focused on apps last years, as they have been seen as "more user-friendly and purpose-built", and account for 90% of time spent on mobile devices. [78] Contrariwise, web AR is roughly 17% of present AR usage but is expected to have the biggest growth among all, due to its compatibility with more than 3.06 billion global smartphones and its employment in browser-based experiences that spread through universal web links, rather than forcing app downloads. [77]

Web AR facilitates non planed or quick AR shopping experiences, contrary to the conflict that generates the "activation energy" required by app stores and downloads that diminishes the already difficult adoption of AR. Despite its reach, it has the least active users which are awarded to its early stage more than to a lack of value, and it suffers from the recent stronghold of social apps that introduce AR into trendy activities that can be shared. [78]

Visual search
On the other hand, visual search is less mature than product visualization. It usually needs more complex technology, like computer vision, which helps detect real-world items (ac) by pointing a smartphone camera at a given product to identify them or obtain information. (ag) It is expected to have a huge monetization capacity as it goes from 238 million in consumer expending last year to 6.4 billion dollars in 2024 (ag).

Its growth is coming mainly from platforms like Google and Pinterest that increase user's intention to participate by scanning items (ag) and facilitate and speed up purchases. However, its usage has decreased recently because of Covid restrictions, as its main purpose resides in the discovery of products in real-world environments. (ac) That is why for the purposes of this study, it will not be considered as it does not contribute significantly to the prevention of returns in e-commerce, as well as social lenses and in-game AR.

Advantages
AR is expected to address the problem of expectations and lack of detail and information that creates doubts and discourages the customers. But, to achieve those goals it needs to be in the shopping flow, which means it should be placed and aligned directly to the user's path, triggering comfort and cognition without taking the user on a journey through multiples apps or websites. This condition drove the creation of the "AR as a feature" approach, which fosters the use of AR experiences in existing (non-AR) apps to reduce adoption friction. It integrates AR in sparing ways that are organic and additive to an already prevalent activity and is successful because it meets users in the apps they already use. [77] For example, Facebook and Snapchat. In the case of Snapchat, the feature of Snapchat lenses can be highlighted, since AR has been infused within non-AR apps.

AR encloses many different benefits mainly related to the improvement of customer experience and purchase intention, and the reduction of product returns. The most simple but relevant use of AR is its capacity to enable more informed purchases through dimensionally accurate product-visualization on "faces & spaces", [79] which enhances consumers' awareness and understanding of product features and more importantly, gives the customer a picture of the performance and usability of it in their own context and environment. Moreover, it saves the user transportation and shopping time, which is one of the main reasons for customers to actively use e-commerce in the first place.

It is also known to offer a more vivid product visualization associated with a more positive emotional response that improves customers' search experience, thereby enhancing perceived media usefulness in shopping experiences and purchase decisions. AR for product visualizations provides and fosters innovation, immersion, enjoyment, and usefulness by giving the customer a way to see themselves wearing an item in case of virtual try-ons or testing products in spaces. It results in effective communication of the product characteristics, in turn resulting in positive responses toward the experience and increased purchase intention, compared to traditional product presentations. [71]

It was checked through a study developed in reference [71], that AR-based experiences turn out to be better than traditional web product presentations in terms of novelty, immersion, enjoyment, and usefulness, creating a better attitude towards the medium, and hence, higher purchase intention, as shown for two different product categories, sunglasses and watches. A different set of studies back this information demonstrating the tendency of customers to provide positive evaluations "from both affective (e.g., enjoyment) and cognitive perspectives (e.g., product knowledge)" of an immersive experience.

Furthermore, as AR aims at providing an "informed purchase", it can reduce returns while drives conversion. The visualization of products and try-ons give consumers unconstrained attempts to visualize product measures, shapes, and colors to get a more conscious and assured decision, consequently decreasing returns caused by obtaining a product that looks different from what was expected. Product visualization also addresses the problem of ill-fitting products, particularly when are linked to big items as furniture, that requires the physical space understanding. It could help to visualize better clothes, but there are more effective methods to tackle this.

One clear example is the company SeekXR, that through AR-guided purchases achieved 25% fewer returns compare to competitors without AR experiences. [75] The company works with Overstock.com with which attained around 80% increase in conversion and 5 times more site interactions according to AR insider Magazine. [79] Other companies like Shopify are increasing their conversion and decreasing returns through visualization tools like Apple's QuickLook to facilitate the use of AR.

AR brings sustained value as a shopping tool in several e-commerce scenarios as it brings more context and confidence to product purchases. These qualities can be seen in situations like the current COVID-19 emergency, which shows how AR has brought back some of the product

dimensions and tactile details that have been taken away from the consumer during lockdowns. In "normal" times the advantages are evident but the forced adoption of technology during the pandemic has led to a positive and permanent change of consumer habits.

The challenges

AR is still a new technology, and for that, it faces some implementation challenges. In 2018, BCG Analysts performed a survey with 55 companies about the main reasons to resist the adoption of AR on advertising. [80]
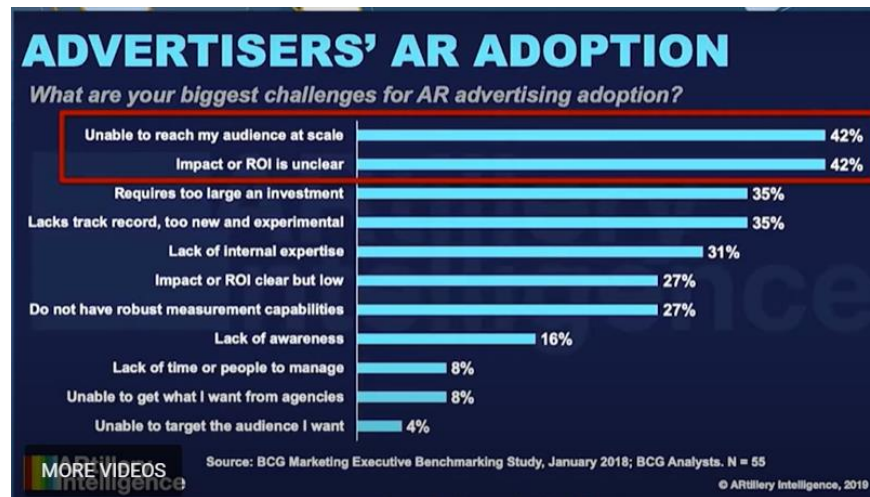

Figure 20. Challenges for AR advertising adoption [80]

Even if the purpose of the survey is not extended to all forms of AR, it is indicative of the acceptance of the technology and the path it should tech next years to solve these issues. This study reveals that the main concern of around 42% of respondents is that AR is "unable to reach their audience at scale". Also, for 42% of companies is the "impact on ROI is unclear". It is expected since technology is not yet available to everyone and requires an investment, which is the problem in third place with 35%: "requires too large an investment". After this, most of the issues posed by AR are related to the lack of capabilities, people, and knowledge required to manage this tool, and not to the results of its implementation on customers.

There is still a lot of room for AR to improve regarding consumer engagement in virtual shopping to provide a most satisfactory media option. In general participants are positive about AR because it is a new technology but ironically, they are also negative about AR because the new technology offers a variety of forms of discomfort in the utilization process. This led to the challenge to increase AR medium familiarity resulting from increase time spent in AR medium. However, its use will reduce consumers' motivation to be mentally immersed when using AR. Users with more prior AR media experience see AR as a more familiar stimulus, hence, reducing the AR novelty effect.

If the previous challenge is approached from the perspective of the habituation-tedium theory, which proposes that the tension and uncertainty created by an innovation wear out as users are repeatedly exposed to and become familiar with the change. [82] The theory asserts as well, that

the pace of growth of consumer tedium is faster than the pace of growth of habituation, which is the principal reason to keep innovating constantly in AR and carry on engaging and new strategies for customers. Tracking the results is always helpful to pave the way in which the technology should be developed and make the most of the experience.

Case study: "Build with Ferguson"

One representative example of the implementation of AR is the American company "Build with Ferguson", an online store for home improvement that sells bathroom, kitchen, and lighting hardware and appliances. In an alliance with the mobile experience provider "Prolific Interactive", they created an app that could help the customers to see how the products will look and fit in their houses, offices, or other environments. The experience was called "In-Home Preview" and was created taking advantage of the technology released by Apple called 'ARKit'. This tool uses world and camera coordinate systems together with a method called visual-inertial odometry, which combines information from the iOS device's motion-sensing hardware with computer vision analysis of the scene visible to the device's camera. 'ARKit' recognizes notable features in the image and tracks differences in the positions of those features across video frames while compares that information with motion sensing data. The result is a high-precision model of the device position and motion.

This technology provides a practical, usable tool for the customers where they can find all the information of each product and more important, is possible to scale 3D models that can interact within the existing environment. From turning on light fixtures to adjusting a faucet, customers can realize how the product will fit and work in their space with the options to switch between various products all in the same device.

Figure 21. "In home preview" AR app

Build with Ferguson launched the augmented reality tool in 2017 that allows customers to see their products (over 650 products and 1700 stock keeping units) and to scale in 3D with their smartphone screens. The augmented reality tool had been a good implementation; after a year of analyzing customer behavior, the return rate for customers who used the augmented reality function was 22% lower than customers that didn't use the tool and bought the same product. [83] Most of the returns left are related to quality or delivery problems, moreover, the problem of

how the product fits or interacts in the environment is overcome thanks to the possibility of the tool to ensure that it will function in the space. For example, the augmented reality tool lowers the rates of those faucets that were returned due to the way the handle moves or hits the backsplash. Over 5000 customers use the tool each month and those shoppers that use the AR tool on average have twice as likely to return to the site or app than other clients. [83]

Case Study: The Makeup Industry

The makeup industry has been working to go beyond limits for the needs and expectations of the customers and especially keeping good numbers in terms of cost and profits. Since 2017 multiple companies were planning to invest and implement innovations like "Smart Mirrors". These digital mirrors were first employed by MAC in their stores, helping to identify the first impressions of the customers with this technology. Later, the Covid-19 emergency accelerates the introduction of this kind of tool in the physical and digital market especially at a time when customer habits and the retail environment continue unpredictable. Consequently, multiple makeup companies have introduced AR try-on tools as a strategy to reach those customers affected by the emergency and as a long-term shoot to engage consumers with this new experience.

Nars & FaceCake

FaceCake, a marketing technology company that creates AR online and in-store experiences for brands decided to join the brand NARS, to bring a new virtual try-on matchmaker, powered by AR. It can instantly suggest an ideal foundation shade and formula based on skin tone. All the experience can be used on mobile devices or computers. On average a 350% to 400% increase in monthly conversion and online basket size have been seen after the implementation of the AR tool. [84] Moreover, AR technology helped reduce returns by a percentage that smart mirrors increased in the conversion of customers.

L'Oréal & Modiface

ModiFace, founded by the University of Toronto became a global market leader in augmented reality and artificial intelligence for the beauty industry. L'Oréal acquired ModiFace in 2018 as a major step in reinventing the customer experience. The tool can diagnostic and analyzes the skin of the clients and produce a customized beauty routine based on an AI algorithm, additionally, it allows them to try on hundreds of looks in a matter of minutes. This technology has double the website engagement time and triple conversion. Moreover, L'Oréal has begun to allow third-party platforms like Facebook, Instagram, and others to use the technology, letting consumers navigate to a brand's Instagram page, find a product, and virtually try it on before buying, allowing companies to get faster the attention of the potential customers in social media. Even though open sourcing might be a surprise given that L'Oréal invested in ModiFace, the platform aims to scale, so the more people using it, the better its capability will be.
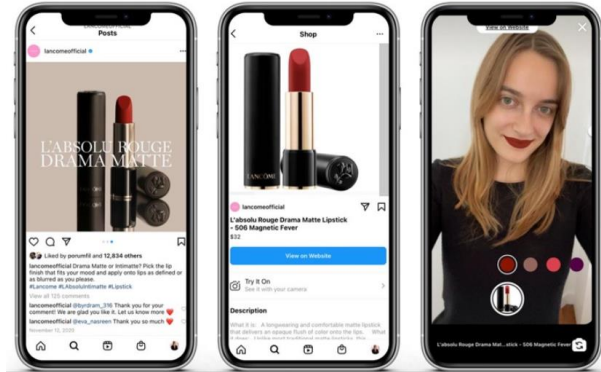
The reach of this tool is not only limited to its use, but it extends to the innovation brought to the market, calling the interest of companies like Amazon that became the latest retailer to embrace it. L'Oréal creates a collaborative space called "Web Lab" in which they learned about each other in which L'Oréal learned and expanded beyond virtual make-up to other product areas. L'Oréal introduces a virtual hair color try-on, which is the same principle as the make-up tool.

Sephora & ModiFace

Sephora joined multiple businesses that recognize the importance of implementing AR in the market. They count on the support of the company owned by L'Oréal, ModiFace, and create an update to his store in the app, adapting all features to his own products. Sephora makeup app called "Sephora's virtual artist app" uses facial recognition to empower customers to try on products anywhere, the app scans the face and detects eyes, lips, and cheeks for product placement and offers multiple choices of products to try and compare. This tool drove more than 200 million customers through more than 85 million visits to the try-on app, which is a representative number of clients to increase awareness. [86] Having in mind the importance of nowadays need of stores to eliminate product testers in a post-coronavirus world, it is a notable outcome.

In general, all the company's implementation shows the multiple benefits of the AR technology in try-on systems and how the new customer habits can make easier and important the application of these tools. Nevertheless, as this technology is still in an early stage, the effect of its implementation is still not clear. All companies agree on the beneficial effect on return rates, but do not provide specific results on the topic. Companies are reaping the immediate gains instead of researching the least obvious outcomes, as is the prevention of product returns. Moreover, it is difficult to evidence which quantities could be related to the circumstance of the covid emergency or the effective engagement of the tools.

3D product visualization

As mentioned, the customer needs and habits nowadays have shown that regular photographs and product descriptions displayed are not enough to generate engagement with customers and their requirements. Technologies like 3D models are a tool that allows companies to create an

environment that fulfills the clients' expectations through live-embed interactive product viewers that render multiple-angle product shots and 3D product views. It is a first step for AR but contrary to this, is less complex, more affordable and provide more detail instead of context.

3D model technologies have changed the way in which companies engage with their clients. Around 60% of online buyers said they would prefer to have a 3D view of the products. [87]. Moreover, there's an extra benefit brought by the possibility of updating the models to reflect product revisions in a really short time. The 3D models bring with them a special feature called "3D product configurator" that allows displaying customizations of products in real-time. The customers have the experience to interact with the products online, make the changes they prefer, and watch them transform instantly. It is not limited to the change of colors, as components and styles can be included in the 3D configurators and also provide dynamic pricing for chosen configurations. 3D configurators for immersive visualization are a representative development in e-commerce, and the construction of a Cloud-based 3D asset can be an opportunity to showcase in a variety of websites and e-commerce platforms. [87]

Customization in the 3D models in any company for their products can be seen as a strong tool along the customer journey, increasing a sense of participation and enhancing brand loyalty. According to reference [88], 80% of consumers are more likely to make a purchase when brands offer a personalized experience. When retailers let customers take control of their products, customers are prone to engage. When customers engage more, they have a better sense of quality. Because they've personalized it in the way they want, they also feel more ownership over their custom product, which means a higher likelihood of converting and a lower probability of return.

3D modeling is not a new technology, but it has been improving its quality along with the development of recent technological tools. It has been used in multiple industries, and even some companies already had a few of these models to create prototypes of their products, but never thought of implementing them in their websites or e-commerce platforms.

The available models can vary from basic ones to specialize models that give high detail through 3D scanning. Nowadays this technology can be implemented in multiple ways but as a foundation of the process is necessary the 3D model of the product in any of the formats available to merge with the platforms in a built-in user interface and create the parameters of how a customer can configure the product on the website.

The technology could be applied as virtual photography, 360-degree product viewer, and 360 spin videos.

Virtual photography

Virtual photography is the digital creation of photorealistic imagery. While not always presented in three dimensions, virtual photography is enabled by 3D renders of products, so that the 3D model can be repositioned within a virtual studio without having to generate new work. [89] This technique has a big advantage: save budget on studios and photographers giving an opportunity

to create the photoshoot in any location or even try out more than one site that the company desire without the expenses. Also keeping updated the digital catalog is easier, avoiding the need to start a new campaign to update the products. All the images could be obtained at a high-resolution image instantly or create multiple-angle product shots adding design elements like colors, lighting, and textures without the limitation of which products were shot before. Moreover, it enables a simpler way for the customization of the products and their visualization which can increase the engagement with the customer.

Costs decrease almost entirely when traditional photography is replaced with virtual photography and a 40% conversion rate increase can be achieved when 3D configurations are employed. At the same time, was found that online shoppers are 20% more likely to buy products they can customize in real-time, and because of this, is less probable that they return them. [14]

Figure 23. Virtual 3D model vs virtual photography

360-degree product viewer.
A 360-degree product viewer is a digital view of a product that shows it from all sides and angles. Customers can rotate, zoom in and out, and explore them as an interactive image. It can be done through a software application that runs on the computer or mobile device browser and engages customers with an interactive experience. The connection between the website and the 360-view software is loaded through the coding of the website and then the viewer loads every individual product image frame and the built-in interface functionality settings control how the 360 images are displayed and how users interact with the product. [90]

There are a lot of 360 product viewers to choose from, most of them with few customizations and features while they are being used in more limited devices, others have a full set of features and allow to customize the product in a lot of ways with enough efficiency to operate on all devices and browsers. The integration of a viewer with any of these characteristics creates a personalized experience that builds a more engaging and high-converting product page than a traditional 2D product image visualization. [87] That is why the 360-degree viewer has become one of the latest trends in the online shopping experience.

In addition, the implementation of the viewer gives to potential customers a sense of control by handling themselves the views and customizing their products rather than the feeling of uncertainty with 2D images, which increase overall customer satisfaction and avoid returns by ensuring a conscious and informed decision. Moreover, 360 viewers for e-commerce can ensure the accuracy of the products and reduce returns by nearly 50%, saving time and money for the companies and the clients. [90]
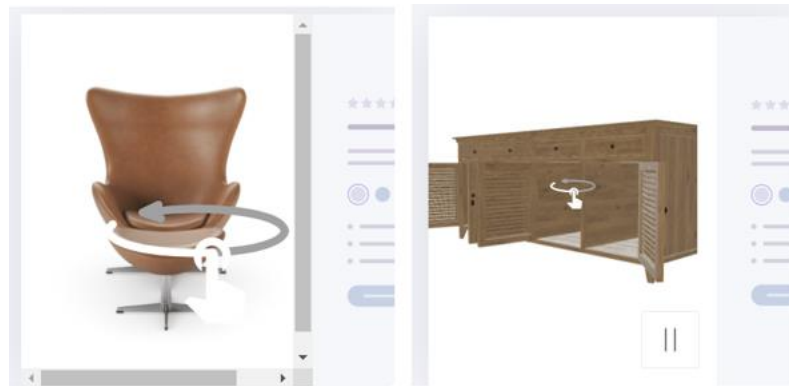

Figure 24. 360-degree product viewer

360 spin video

Another common application in eCommerce is 360° spinning video and interactive 3D product imagery that rotate by itself and can be zoomed. A 360 spin video works like a 360 photography video showing how an object or scene looks when it rotates on its own axis. [76]

Some brands use the same shooting method to create an interactive experience that enables users to click and drag on the product so they can choose their angle, however, it is limited to the 360-horizontal rotation of the video. When online shoppers get an up-close detailed look at their products while also having a certain amount of control, they are more likely to make the purchase and keep it. For example, companies from athletic footwear like Nike, Puma, and Adidas are implementing this tool to improve their experience with clients.

This tool cost slightly more than still images but less than a 360-degree product viewer or a 3D model in a rendered environment, even so, it will likely make up for the surplus since this tool can increase conversions, reduce returns, and contribute to lead-generation efforts when used on social media and email. Moreover, it's possible to create 360° images both in a photography studio and by using the software. The latter is much faster and tends to work better for large inventory catalogs that change frequently.

3D images are useful especially for "complex products" that require a good display of information because are composed of several pieces that can be modified or customized, or for relatively expensive products where the customer usually has a good knowledge of the characteristics of it, needing a more comprehensive assessment. Thus, the company can benefit from the interactivity of the viewer to take the consumer on a journey along with detailed information about the

product. A few examples are vehicles and robotics, which count with a very high level of detail and increasingly are being purchased online, or at least the decision to buy them is made online.

The most important gain for the customer is getting direct access to enriched content and customization capabilities. But it is important to note, though, that most 360-degree images don't offer any context for the products. To increase the presence of the 360-degree images is necessary to go beyond a standard white background and include lifestyle images, establishing scale and creating a narrative around how, when, where, and why customers should use the products. Therefore, now the models are introduced into AR environments to give certain context to the product and increase their understanding.

Case: Shopify

Shopify introduced around 2019- 2020 a built-in support for 3D models and video in the platform. The feature would allow vendors to upload 3D models or videos directly to the product pages without the need for custom code or a third-party app. This strategy was executed simultaneously with the implementation of augmented reality (AR) because the technological implementation of AR allows the customer to put the 3D-scale model in a selected environment. Both 3D and AR create a complete strategy to increase customer satisfaction and reduce returns through the fulfillment of the customer's expectations and fit needs. Shopify reported that some companies that integrated the strategy have increased conversion rates up to 250% on product pages and have shown a decrease of 40% in returns for merchants. [91]

Luxury retailer Rebecca Minkoff CEO of Uri Minkoff has been using 3D models on its Shopify project pages and said customers were 65% more likely to make a purchase after viewing a product in AR. Shoppers want to "understand the texture and structure of every bag and envision how they'd feel wearing each piece in a collection," said Rebecca regarding the technology. [91]
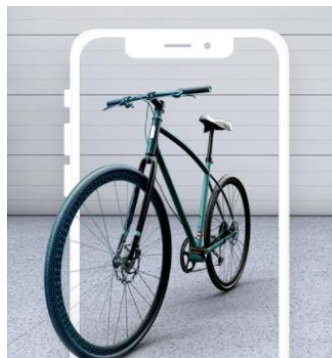

Figure 25. 3D model and AR Shopify solution

Conclusions

It is evident that technology is closely related to innovation, and innovation is the cornerstone for growth. Competitive advantage depends on the ability of companies to leverage new resources to develop a compelling offer, which in this era has a lot to do with the development of tools to adapt to customer behavior and their habits. The level of congruence between these tools and customer's needs is the measure of how good they can impact the performance of an e-commerce business. As e-commerce becomes increasingly central to companies and people in everyday life, it is important to understand how technology can be used to improve the online customer experience to influence customer behavior, particularly, in this case, product return behavior.

The main element to prevent returns is to get the customer to completely understand the product, its features, and functionality within the context is going to be used. The fact that e-commerce cannot provide this, is not only the cause of returns, but of churn, poor engagement, and loss of profits. An experience that can provide a clear understanding of products in the pre-purchase phase of the customer journey, is a synonym of assurance. When a customer is sure about what is getting, is less inclined to return it.

While the impact of returns in operations is by now common knowledge, companies fail to foretell the use of online experiences to prevent returns and to drive conversion. For this purpose, technology plays an important role, as it can provide an engaging and interactive way to display products, as well as an efficient method for companies to analyze data, both useful to influence customer's purchasing decisions.

The common issues to solve are related to fit, misleading expectations, or problems derived from lax policies, but companies need to isolate their products and customers to understand the experience they should provide since different tools are suitable for different purposes. For instance, a fit assistant is the most adequate tool for the apparel industry. The provision of quick size recommendations is the best way to avoid returns since the main problem is ill-fitting products. It is a simple but effective solution that can provide a huge understanding of customers, and data to support future strategic decisions.

However, nowadays only big companies and retailers have this tool. Small and medium companies tend to remain in traditional strategies (descriptions and reviews). Fit assistants can integrate into the standard operation of any apparel e-commerce company, which could be done easily through multiple companies in the market that work only in the implementation of this technology, and their pricing is based on the number of monthly orders, which facilitate small companies to consider this upgrade in their websites or apps. Nevertheless, is necessary to highlight that even if the technology is close at hand to companies, there is still a lack in development for its adjustment to all user's needs and particular expectations. The same logic applies to the use of Artificial Intelligence, but contrary to fit assistants, its scope is wider than the apparel industry. It does not solve a specific problem for the customer but is able to persuade them to change their actions to avoid returns.

On the other hand, AR has shown to be a good tool to overcome problems of misleading expectations, especially those related to customers' uncertainties about the appearance of an object and their fit within environments they want to use it. Moreover, the power of innovation makes AR a trendy and useful tool that creates its own publicity by the originality that represents, attracting customers, and more importantly, fulfilling their expectations with respect to a brand.

However, AR is not well developed yet in fields like accessibility and compatibility. In terms of accessibility, there's a barrier. Right now, only the biggest companies have an R&D department devoted to the application and improvement of this tool. Even if last year's new technologies like "ARkit" opened new bridges to multiple vendors to access technology, there are still obstacles in terms of the platforms to introduce the AR output from the "ARkit". For example, right now only big companies like Shopify allow that kind of free third-party code that lets vendors join their AR products, but if they do not want to sell in Shopify or want to use AR in their own apps, it could cost more. External consultants could do it but at a representative cost. In terms of compatibility, the technology in general still needs to evolve and wait for the world to evolve with them due to the difficulty posed still for some devices to handle AR with 100% fluency.

Due to this problem of accessibility, many companies have decided to implement 3D models to fight against misleading perceptions of the products, as they give a very detailed view, but without a context or dimension. 3D models and all their modalities create on-budget solutions to go further than the traditional 2D photography, creating spaces to easily help customers to fulfill their expectations on customizing products, decreasing returns and their consequences. It is not complex to access this technology as many third parties offer these kinds of services, or it could be managed by their own R&D teams.

The market of external consultants currently provides a service to help retailers incorporate 3D models, offering a coupled option with AR due to the good complementarity between these tools to extend a more complete experience. They charge by the creation of the model separately from the implementation of the embedded feature and other configurations needed on the website or app. It also includes the tools to do the analytics assessment related to the interaction of the customers with the tools, which is a valuable feature for companies as many of them limit themselves to provide the model but are not able to collect insights about customer behavior and journey.

In general, one of the biggest problems of the adoption of these tools is the lack of data. Since the reduction of product returns came as a secondary and indirect consequence of these solutions, there is not enough evidence from early adopters to attract and convince less knowledgeable companies. Their perception of uncertainty about the adoption of new technologies overshadows the benefits, making them reluctant to implement any solution. However, with the evolution of

enabling technologies and devices like mobile, the adoption is expected to spread and conquer e-commerce in the future.

None of the tools explained in this document represent a complete solution to the return problem. The accomplishment of this goal needs a multiapproach strategy that can vary between the product, industry, and market in which will be implemented. However, the strategy to use should always have as a core the customer experience and its ability to fulfill the customer expectations. In the end, the purpose is to offer customers a way to find all the information they need about a product in the spot and time they look for it, because if they need to go somewhere else for information probably will desist from the purchase, or buy without been sure, meaning will probably return it, thus, the main tool to prevent returns is to offer closeness and fulfillment.

The learned lessons of the use of these technological tools go beyond the improvement of understanding of their applications. It should support the creation of strategies and return policies that not only adjust to the customer but also to the company, in order to create a more efficient supply chain that allow them to grow without affecting the loyalty of customers and at the same time detecting and avoiding those who abuse of it.

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