Enhancing Returns Management in Fashion E-Commerce: Industry Insights on AI-Based Prediction and Recommendation Systems

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Abstract: The fashion industry is one of the most problematic sectors in terms of sustainability. The fashion e-commerce sector is experiencing a surge in sales, which is leading to a significant increase in returns. This, in turn, is placing a considerable burden on the environment. High transport volumes or even the destruction of garments through returns pose major environmental and also economic problems. This study is based on a survey and expert interviews with decision-makers from the fashion industry. It provides indications of how an AI-based prediction and recommendation system could be used to avoid returns and manage them in an ecologically and economically sensible way. On the one hand, use cases are discussed that can be applied in the webshop system before the customer places an order, and on the other hand, ways are shown how returns predictions can support planning in the reverse logistics network.

1 INTRODUCTION

E-commerce grew rapidly during the coronavirus pandemic. The share of e-commerce in total retail sales increased from 15% in 2019 to 22% in 2022 (Morgan Stanley, 2022). This growth will continue after the coronavirus pandemic. Annual growth of 9.91% is expected for the years 2024 (€3,334.00 billion) to 2028 (€4,865.00 billion) (Statista Market Insights, 2024). Growing e-commerce sales are accompanied by increasing transport volumes and higher volumes of returns. As a result, e-commerce is focusing more and more on reducing returns and managing them more sustainably. This can be done, for example, by using size finders which help customers find a garment that fits their individual body shape. In fashion e-commerce, the fitting room is often moved from the store to the consumer's home to overcome a major drawback of e-commerce compared to bricks-and-mortar retail: the customer wants to see, touch and try on the product. It is therefore difficult to eliminate returns completely (Asdecker and Karl, 2018; Lohmeier, 2024).

The fashion industry accounts for most of the returns in the e-commerce sector. Of the 1.3 billion items returned in Germany in 2021, 91% were clothing and footwear. Comparable patterns of consumer behaviour can be observed at the European level (Forschungsgruppe Retourenmanagement, 2022). The issue of increasing product returns is adding to the pressure on an industry that has long been criticised for its poor environmental performance. This is the starting point for this research project. To tackle the problem of high returns, manufacturers and retailers have the opportunity to work on preventing returns through preventive measures such as sizefinders, or to improve the environmental and economic impact of returns through reactive measures such as adjustments to returns logistics or a suitable second life plan for the returned garment (Deges, 2021; Gry et al., 2023). As studies have already demonstrated, AI-based returns predictions at the shopping basket level afford manufacturers and retailers a multitude of options: These include both 1) preventive measures to avoid returns and 2) reactive measures in the form of adjustments to the reverse logistics network or the second life cycle of the garment (Gry et al., 2023). The corresponding potential applications of an AI-based prediction and recommendation system are discussed in expert interviews with decision makers from the fashion e-commerce sector. The findings of these expert interviews will be integrated into the design of an AI-based prediction and recommendation system. This will provide valu-

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able insights into the optimal points in the ordering or returns process, and thus in which system (e.g. in the webshop system or in the ERP or PDM system) AI-based predictions can be most beneficial. Previous research has shown that AI-based predictions have advantages over mathematical models or simple data mining models when it comes to predicting returns, for example (Gry et al., 2023; Niederlaender et al., 2024). In particular, Niederlaender et al. (2024) have shown that machine learning approaches deliver promising results in predicting returns in fashion e-commerce. In light of the aforementioned considerations, it is similarly assumed in this paper that AI-based predictions will be employed.

The structure of the paper is as follows. First, a brief literature review presents the factors known to influence the likelihood of returns when customers place orders. Secondly, the results of a survey on returns management among fashion retailers and manufacturers with e-commerce activities are presented. Then, key findings from expert interviews with fashion e-commerce decision makers regarding the use of AI-based predictions to avoid and manage returns are provided. Finally, the implications of the survey and expert interviews for the development and possible system integration of AI-based prediction and recommendation systems in the context of returns (avoidance) are discussed. The paper concludes with a summary of the findings, identified research gaps and an outlook.

2 METHODOLOGY

In the first part a literature review reflects the current state of research on the factors that influence consumer return behaviour. This knowledge can be used to support the selection of relevant variables and the creation of features in the context of machine learning for AI-based returns predictions and to create a basic understanding of the relationships between returns and consumer behaviour (Niederlaender et al., 2024). This knowledge also serves as a basis for discussion in the following expert interviews.

To this end, a literature review was conducted, focusing on a period between 2018 and 2023, and was carried out in November and December 2023. Springer Link, ScienceDirect, Wiley Online Library and Google Scholar were used, supplemented by snowballing techniques to include relevant older sources outside the primary time window. The following keywords were used in combination with the keywords Fashion, Apparel and E-Commerce: Consumer Return Behaviour, Product Return Prediction, Consumer Return Behaviour, Prediction of Consumer Returns.

In order to subsequently contribute to answering the question of how AI-based predictions can be used in practice by manufacturers and retailers in fashion e-commerce, a survey was conducted among manufacturers and retailers on the one hand and expert interviews with decision-makers on the other. The results and implications of which were analysed with regard to an AI-based recommendation system based on returns predictions.

3 LITERATURE REVIEW

The following brief literature review serves to highlight the relationships between possible independent variables, such as customer or product-related data or payment methods, and the dependent variable of the probability of returns. This was done in order to build up a sound knowledge base on the occurrence of returns and to be able to use this knowledge for the expert interviews and for the development of the AI-based recommendation system.

Product and Customer Related Data. Asdecker et al. (2017) found that the most important factor in determining the likelihood of returns is historical returns data at the item and customer level. If a particular item has a history of frequent returns, this, together with historical returns behaviour on an individual customer basis, is the most important variable in determining the likelihood of returns.

Shipping Costs. Studies have shown that eliminating shipping costs as part of promotions encourages consumers to order more goods for which they feel uncertain about the purchase decision (Saarijärvi et al., 2017). This in turn leads to a higher rate of returns (Shehu et al., 2020). Many online retailers waive return fees above a certain turnover threshold. This has also been shown to increase return rates, as Lepthien and Clement (2019) found in a study conducted with a streetwear and sportswear retailer.

Payment Methods, Price and Promotions. In their study, Yan and Cao (2017) found that payment methods that exclude prepayment lead to higher return rates than payment methods that require prepayment for goods. For example, using data from an online retailer of shoes, clothing and accessories, they showed that credit card payment leads to a ”buy-now-pay-later” attitude, which encourages impulsive buying and increases the return rate. Customers also perceive it as a

lower risk if they do not have to pay in advance (Sutinen et al., 2022). Paying in advance is more likely to be associated with a deliberate purchase decision, which is reflected in lower return rates. Similar results were found by Asdecker et al. (2017) and Makkonen et al. (2021). Sahoo et al. (2018) show that the price of the garments sold also influences the likelihood of returns. They found that more expensive garments are less likely to be returned than cheaper ones. One reason for this could be that more mental effort is invested in the purchase decision, which is reflected in lower return rates. On the other hand, coupons lead to customers being urged to make what they consider to be riskier purchasing decisions, which in turn result in higher return rates (Asdecker et al., 2017).

4 SURVEY

In the context of the returns problem described above, a survey was created which was sent to contacts from the fashion industry in Germany via LinkedIn and newsletters. The aim of the survey is to find out the status quo of the companies with regard to their online business and their returns volume and to find out about strategies that have already been applied to improve the handling of returns.

4.1 Methodology and Data Set

The survey was conducted in German language and consisted of 30 questions in total. The survey consisted of a total of 20 checkbox questions with predefined answers and the option of manually entering additional answers. Cocurring manual responses were summarized as part of the analysis. The 20 checkbox questions included:

1. The perspective of the respondent: retailer or manufacturer/brand?

2. – 4. Are the products offered via a marketplace such as Zalando, Amazon or About You? Are the products exclusively offered via a marketplace? Which marketplaces are used for selling the products? Options include Amazon, Zalando, AboutYou, Otto and manual input fields

5. Which fulfillment components are utilized via the marketplaces used? Options include storage, picking, shipping, processing of returns and manual input options

6. The product categories offered for sale at the market place or own store

7. – 10. Does the shipment via the shop or marketplace include a returns label? Does the shop or marketplace collect data on the specific return reasons? Which specific return reasons are collected? Are returns reused by the shop or the marketplaces that serve as a sales platform (e.g. in the sense of reshipment)?

11. What specific reuse options are employed by the shop or the marketplaces?

12. Are customers charged for the return shipment of their returns?

13. – 15. Does the store or marketplace used determine return rates by product category? Are the costs incurred in the context of a return (shipping, processing, refurbishment, etc.) being calculated? Is a shop-internal or an existing analytics solution within the framework of the marketplace used in the returns context?

16. – 18. Are return probabilities determined depending on the contents of the shopping cart? Is a returns history kept on a customer basis with items returned in the past? Are returns probabilities determined on a customer basis?

19. Which of the following evaluation options are used in the context of returns management? Correlation between fit forms, correlation between customer group and probability of returns, correlation between product group and probability of returns, or no further evaluations

20. Are there plans to address the issue of returns processes through initiatives, projects or process changes in your company?

In addition, 4 questions were asked to estimate the returns rate and the reuse rate of various clothing categories, the customer friendliness of the particular returns process currently in use, and the share of online business in total sales. Remaining 6 questions were posed with an input field to enter missing product categories or to enter values like the number of employees and year of foundation, time frame of the right of return, the return fees the customer is being charged, the costs of a single return for the company, or to enter specific plans to improve the returns process. The answers were analysed using histogram plots, and both the percentage distribution of responses and the number of participants were taken into account. In the case of estimation questions on the return rate and reuse rate of various product categories, the aggregated percentage of all participant responses was evaluated for each category.

4.2 Main Results

60 people from companies in the fashion industry took part in the survey. The response rate varies from question to question and is therefore stated for each of the mentioned results in terms of the number n of participants on that particular question. Although n is

too low in some cases to make a statistically significant statement, the authors decided to present these subjective estimations by experts from the industry as a qualitative insight and as preliminary findings that draw attention to possibly emerging trends.

The participants in the survey are working in fashion companies with a large share of online business in total sales ($n = 11$): 33% of respondents state the share of online business to be above 90%. The average share of online business over all respondents is 80%. The average number of employees is around 200 ($n = 10$).The participating companies range from long-established companies to young companies, founded between 1916 and 2015, with an average company age of 50 years.

62% of respondents belong to a manufacturer or brand, while 38% are retailers ($n = 34$). 76% offer their products via a marketplace ($n = 34$), while only 4% are exclusively using marketplaces to sell their products ($n = 26$). The most frequently named marketplaces are given by Amazon (24%), Zalando (19%), Otto (18%), AboutYou (10%), and Breuninger (4%) ($n = 20$). All of the respondents working with a marketplace utilize storage and shipping as part of the fulfillment offered by the marketplace, while 80% of them also utilize picking and processing of returns ($n = 10$). The mentioned product categories sold via the online shops and marketplaces include, but are not limited to the categories mentioned in Figure 1 a) and b). Even though including a return label in the package may be a restriction on the further processing of the return, 60% of shops or marketplaces decided for this option ($n = 20$), which might be due to improved convenience for the customer in the returns process or because options to route the package flexibly is possible even with a given returns address on the label. This is in accordance with the fact that 25% of respondents ($n = 20$) rate their returns process as extremely customer-friendly. The average rating of customer friendliness is at 3.5 out of 5, where 5 marks an extremely customer friendly process. The large majority (80%, $n = 20$) of shops and marketplaces also collect the reason for return. Return reasons collected and their share over all answers are the following ($n = 15$): Product too large or too small: 24%; product is defective: 23%; product is different than described: 16%; bad purchase: 16%; poor quality: 13%; better offer discovered: 5%; price: 2%; wrong item received: 2%.

11% of respondents state that returns are not being reused by the shop or the marketplaces that serve as a sales platform in the sense of reshipment ($n = 18$). Types of reuse and processing of returned items and their share over all answers are the following ($n = 16$): Reshipment: 55%; Recycling of goods: 17%; Disposal of goods: 14%; Repair: 3%; Second life in own stores: 3%; Secondary marketing: 3%; B2B warehouse marketing: 3%.

The aggregated estimates of reuse rates for different clothing categories are shown in Figure 1 a) ($n = 10$). According to these results the estimated amount of non-reused returns can have a high impact on the resource efficiency of companies, depending on the amount of products sold, which should not be ignored in the future strategy of the companies. Also, it becomes clear that the estimates fall below the measured values of Forschungsgruppe Retourenmanagement (2022). The time frame for the right of return is between 14 and 60 days for 79% of respondents ($n = 14$), where the average time frame is at about 60 days, which may be due to the comparably long time windows offered by marketplaces, exceeding the 100 day mark. In Germany, it is common practice for fashion e-commerce companies, especially marketplaces, not to charge return fees. The findings are consistent with this: 94 % of respondents ($n = 16$) do not charge return fees. If return fees are being charged, it ranges around the standard shipping costs of a parcel, which at the point of writing this paper spans around €4-5. The survey respondent charging return fees has quoted €4.20 as the return fee.

Based on question 13, the vast majority of respondents (69% ($n = 16$)) do not collect return rates by product category. The aggregated estimates of the return rates for different clothing categories are shown in Figure 1 b) ($n = 3$). However, the return rate is highly dependent on the specific company and their unique operation setting. Half of respondents do not calculate the costs incurred in the context of a return in the sense of shipping, processing, refurbishment and other processing steps ($n = 16$), while 12% do so exclusively via the marketplace. The remaining 38% also calculate the costs of a return in the scope of their own online business. The stated costs of a single return span from €6 to €20 with an average value of €10, which stresses the point that for many companies, it may not be economically feasible to process and reship returns. Most respondents (67%) are using a shop internal analytics solution for returns, 33% use an existing analytics tool provided by the marketplace ($n = 10$). Nevertheless, only 14% ($n = 14$) state that they determine return probabilities depending on the contents of the shopping cart, which is an important indicator for bracketing behaviour, where customers order a selection of items with the intention of only keeping a subset of them (Bimschleger et al., 2019). Nevertheless, 64% ($n = 14$) collect a customer-dependent returns history, which is an important factor for estimating future returns behavior and

for determining a returns probability (Niederlaender et al., 2024). An overview of which kind of evaluation is being performed is given by the responses on question 19 ($n = 8$):
Correlation between fit forms: 7%; Correlation between customer group and probability of returns: 7%; correlation between product group and probability of returns: 33%; no further evaluations: 53%. Based on the answers in this paragraph on analytics methods currently used, we can see a trend towards partial data aggregation. The answers also suggest that there is no large focus on further evaluation, the results of which could potentially be incorporated into current strategies for actions in the context of avoiding or processing returns. Based on the responses on question 20, 64% ($n = 14$) plan to address the issue of returns processes through initiatives, projects or process changes, while 29% do not have any plans doing so. The remaining 7% employ strategies exclusively via the marketplace. Some of the initiatives planned by respondents to improve the returns process or decrease returns are ($n = 8$):
Better fit guide; flyer in the parcel for a more conscious online shopping; introduce a return management system; more repairs in retail; automated product sales channel selection controlled by excessive returns; improvement of shipping process: Speed, better package material, including benefits.

5 EXPERT INTERVIEWS

To complement the mainly quantitative results from the manufacturer and retailer survey, expert interviews were conducted to provide qualitative insights that can be used to inform the development of an AI-based prediction and recommendation system, and as an important basis for where this system could be integrated (ERP or PDM system, webshop system).

5.1 Methodology and Companies Included

The expert interviews were mainly conducted in January and February 2024 with decision makers from seven fashion retailers with a strong connection to fashion e-commerce. Four of the seven retailers also have bricks and mortar stores. This is particularly relevant in the context of adjusting returns logistics based on AI-based predictions, for example, when a return should be sent directly from a customer to a particular store rather than back to the central warehouse. Each interviewee was presented with the basic idea (Figure 1 c)) of how returns predictions are determined and what they can be used for, for example.

Using an interview technique, the main principles of which can be traced back to the so-called Mom Test by Fitzpatrick (2013), the interviewees were asked to reflect on the use of AI-based return forecasts in their respective companies. This open-ended interview technique was designed to minimise priming. The interviews were all scheduled for a period of 45 minutes. Further details on the companies and decision makers interviewed can be found in Table 1. In order to cover as broad a spectrum as possible, the expert interviews were conducted with companies of different sizes and with different product ranges. In the following explanations, the key findings from the expert interviews regarding the use of AI-based returns prediction in fashion e-commerce are considered from the perspective of returns avoidance and the adaptation of reverse logistics in terms of a sustainable supply chain. The experts' comments are also used to illustrate the systems into which the return forecasts can be integrated.

5.2 Main Results

Avoiding Returns Through Transparency. In the expert interviews, making the likelihood of returns transparent to customers during the ordering process was seen as an interesting application area for AI-based returns. As five of the seven retailers surveyed stated that they use a size finder in their webshops to help customers choose the right garment, they see a combination of returns prediction and size finder as particularly attractive. For example, if the system determines from the contents of the shopping basket that a particular item has a return probability above a threshold of a certain percentage, a pop-up in the order process could recommend the use of the size finder in the webshop system. Another possible use case from a practical point of view is the charging of a return fee if a certain return probability is determined for a shopping basket. It must be taken into account that customers may switch to other sales channels that do not charge returns fees. As the expert interviews showed, depending on the estimated likelihood of returns, the returns fee is particularly suitable for companies that are exclusively active in online retailing and do not use other platforms or marketplaces.

Selection of Sales Channels. All companies surveyed consider it extremely important to select distribution channels for newly launched products on the basis of return forecasts based on certain product characteristics. Different sales channels are subject to different business calculations due to their fee systems, which erode manufacturers' margins. This means that selling

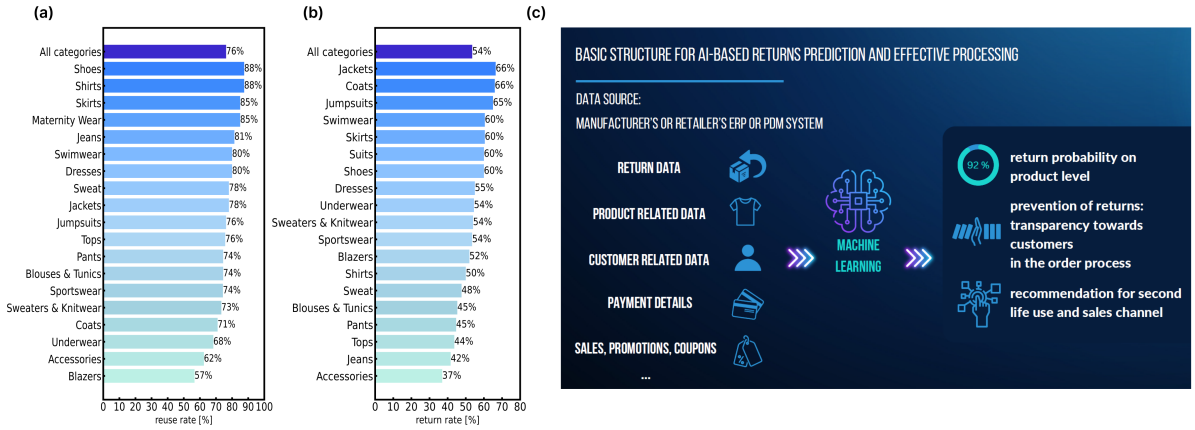

Figure 1: a) Aggregated estimate of the average reuse rates of returns for each product category and the mean over all averages. b) Aggregated estimate of the average return rates for each product category and the mean over all averages. c) Central document shown to the interview partners.

Table 1: Key data about the field of expertise of the interviewees and the corresponding companies.

Company	Role of the Expert	Sales of the Company in 2022	E-commerce Return Rate	# bricks-and-mortar stores in DACH Region	Return Fee
Retailer	Data Science	€1 billion	unknown	13	No
Manufacturer	Data Analytics	~ €100 million	unknown	0	No
Retailer	E-Commerce	~ €200 million	unknown	200	No
Manufacturer	Managing Director	unknown	5%	0	Yes
Manufacturer	Sustainability	~ €30 million	unknown	0	Yes
Manufacturer	E-Commerce	~ €1.8 billion	30%	119	No
Manufacturer	Managing Director	~ €40 million	80%	0	No

through platforms and marketplaces only makes sense for manufacturers up to a certain return rate. If a high return rate means that some products can no longer be sold profitably through certain sales channels, these products could be prioritised for sale in the manufacturer's own online store or in bricks-and-mortar stores, where positive margins can still be achieved. On the system side, returns forecasts would need to be integrated into the ERP or PDM system to inform sales planning and channel selection.

Reverse Logistics Network. Many manufacturers and retailers in the fashion industry operate both online and bricks-and-mortar stores. Returns prediction offers the opportunity to link both worlds in a meaningful way in terms of the reverse logistics network. For example, if it is determined that a customer is likely to return an item that is selling well in one of the bricks-and-mortar stores, a returns label can be sent to the customer with their order that includes the address of a suitable bricks-and-mortar store. This means that the garment does not have to be sent to a central warehouse: If the garment is sent directly from the returning customer to the store, logistics costs can be significantly reduced. This results in environmental and economic benefits for the business. This application of returns prediction is particularly suitable for manufacturers and retailers who operate their own stores. The transferability of this approach to chain stores that divert returns from their online business to bricks-and-mortar stores seems promising.

6 IMPLICATIONS FOR AI-BASED RECOMMENDATION SYSTEMS

The following main implications for the development and implementation of an AI-based prediction and recommendation system for returns (avoidance) emerged from the expert interviews. With regard to avoidance,

the system to be developed can make the likelihood of returns transparent to the customer by integrating it into the webshop system and, for example, directing the customer to the size finder when a certain likelihood of returns is identified. If the customer then uses the recommended size finder, an incentive could be to waive the return fee for that order. The design options in this context are diverse and depend heavily on the existing ordering and returns modalities of the retailer or manufacturer.

In addition, the expert interviews revealed that, from a practical point of view, the returns prediction system is also particularly suitable for selecting appropriate distribution channels, which is also a preventive approach. To this end, it is necessary to check whether the probability of returns can already be determined with sufficient accuracy in relation to product characteristics and sales channels. In this case, it makes sense to integrate the AI-based prediction and recommendation system into the sales planning area of an ERP or PDM system.

A reactive approach where returns prediction is used in the reverse logistics network is, for example, to deliver parcels with a calculated probability of returns for certain items of clothing to customers with a returns label containing the address of a store where the item is selling well. In this case, too, it makes sense to integrate the AI-based prediction and recommendation system with the ERP or PDM system to improve reverse logistics planning. This assumes that other variables, such as sales figures from individual stores, are also available in the ERP system or that the AI-based prediction and recommendation system has access to them via interfaces.

The qualitative survey results reveal that the disposal of returned items is still a common practice in the fashion e-commerce sector. Return rate estimates exceed those found in recent studies (Forschungsgruppe Retourenmanagement, 2022), which may be due to the high dependency of return rates on the specific practices of companies that participated in the survey - return policies, the product range, online sales channels and realistic presentation and description of items play a large role. The return process for the surveyed companies is mostly focused on customer friendliness, which may be explained by the strong influence of marketplaces on the overall behaviour of the market in this direction. A recommendation system would need to be able to act taking the market dynamics in this direction into account and be able to avoid migration of customers to marketplaces if the own online store charges return fees. The survey also reveals that the collection of data on possible return indicators is rather sporadic in a lot of cases and not aimed at a future improvement of the process through the evaluation of the generated insights. An AI-based recommendation system would be suitable to generate insights on return drivers and inhibitors on the basis of sales and returns data, which must be available to a certain extent in every e-commerce company in order to operate. A dashboard view of return rates for different product categories or properties like fit, style, color or size may help with targeting the specific drivers of returns and initiate processes to avoid or improve handling.

7 CONCLUSION AND FUTURE WORK

Growth rates for e-commerce, and fashion e-commerce in particular, will be high in the coming years. This will increase the need for action in terms of avoiding returns and managing returns in the most environmentally and economically sensible way. The survey and expert interviews highlighted the current handling with returns, the relevance of returns avoidance and returns management in fashion e-commerce and provided impetus for the development and system integration of an AI-based prediction and recommendation system. In particular, the expert interviews showed that economic and ecological aspects must go hand in hand when considering the use of an AI-based prediction and recommendation system. As avoiding returns can also lead to a reduction in sales, this requirement is not trivial. Use cases in which return fees are charged on a per-customer, per-basket basis, depending on the return probabilities determined by the system, appear unattractive from a practical perspective in this context, as there is a fear of customers migrating to sales channels where there are no return fees. However, this study has shown that there are ways in which returns prediction can be used both preventively and reactively, without fear of economic disadvantage: On the contrary, the selection of appropriate distribution channels on the basis of returns predictions and sales figures offers far-reaching potential for reducing costs, both economically and ecologically. In this context, integration into the webshop system or the ERP or PDM system can be seen as promising, depending on the described application. In order to prove its practical suitability, the next step should be to analyse a specific use case in which an AI-based prediction and recommendation system is used in live operation in the webshop system or in the ERP or PDM system. It was also not the aim of this study to provide a comprehensive literature review of consumer behaviour in relation to returns, so further research in this area seems appropriate. Furthermore, the sample of manu-

facturers and retailers included in the survey and the seven expert interviews was not representative. Although survey and the interviews were conducted with companies of different sizes and focal points, it would be beneficial to validate them within a larger sample in order to achieve more meaningful results for the development of the AI-based prediction and recommendation system. A field test with customers who are confronted with the concrete ideas of the present study, such as the introduction of return fees depending on the probability of returns determined by the system, could also be recommended. This would allow the effectiveness of the proposed measures to be tested. Nevertheless, AI-based prediction and recommendation systems are not sufficient to address the issue of returns alone. Consequently, it is essential that future research also concentrates on topics such as process optimisation in the context of returns processes and reverse logistics.

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REFERENCES

Asdecker, B. and Karl, D. (2018). Big data analytics in returns management-are complex techniques necessary to forecast consumer returns properly? In *2nd International Conference on Advanced Research Methods and Analytics. Proceedings*, pages 39–46.

Asdecker, B., Karl, D., and Sucky, E. (2017). Examining drivers of consumer returns in e-tailing with real shop data. In *Hawaii International Conference on System Sciences*, pages 4192–4201.

Bimschleger, C., Patel, K., and Leddy, M. (2019). Bringing it back: Retailers need a synchronized reverse logistics strategy. Technical report, Deloitte Development LLC.

Deges, F. (2021). Retourencontrolling im online-handel. *Controlling – Zeitschrift für erfolgsorientierte Unternehmenssteuerung*, 2/2021:61–68.

Fitzpatrick, R. (2013). *The Mom Test: How to talk to customers & learn if your business is a good idea when everyone is lying to you*. Robfitz Ltd.

Forschungsgruppe Retourenmanagement (2022). Ergebnisse des europäischen retourentachos veröffentlicht. https://www.retourenforschung.de/info-ergebnisse-des-europaeischen-retourentachos-veroeffentlicht.html. Online; accessed 2024-03-05.

Gry, S., Niederlaender, M., Lodi, A., Mutz, M., and Werth, D. (2023). Advances in ai-based garment returns prediction and processing: A conceptual approach for an ai-based recommender system. In *Proceedings of the 20th International Conference on Smart Business Technologies - ICSBT*, pages 15–25. INSTICC, SciTePress.

Lepthien, A. and Clement, M. (2019). Shipping fee schedules and return behavior. *Marketing Letters*, 30(2):151–165.

Lohmeier (2024). E-commerce in deutschland: Daten und fakten zum boomenden onlinegeschäft. https://de.statista.com/themen/247/e-commerce/♯topicOverview. Online; accessed 2024-02-29.

Makkonen, M., Frank, L., and Kemppainen, T. (2021). The effects of consumer demographics and payment method preference on product return frequency and reasons in online shopping. In *Bled eConference*, pages 567–580. University of Maribor.

Morgan Stanley (2022). Here's why e-commerce growth can stay stronger for longer. https://www.morganstanley.com/ideas/global-ecommerce-growth-forecast-2022/. Online; accessed 2024-02-29.

Niederlaender, M., Lodi, A., Gry, S., Biswas, R., and Werth, D. (2024). Garment returns prediction for ai-based processing and waste reduction in e-commerce. In *Proceedings of the 16th International Conference on Agents and Artificial Intelligence - Volume 2: ICAART*, pages 156–164. INSTICC, SciTePress.

Saarijärvi, H., Sutinen, U.-M., and Harris, L. C. (2017). Uncovering consumers' returning behaviour: a study of fashion e-commerce. *The International Review of Retail, Distribution and Consumer Research*, 27(3):284–299.

Sahoo, N., Dellarocas, C., and Srinivasan, S. (2018). The impact of online product reviews on product returns. *Information Systems Research*, 29(3):723–738.

Shehu, E., Papies, D., and Neslin, S. A. (2020). Free shipping promotions and product returns. *Journal of Marketing Research*, 57(4):640–658.

Statista Market Insights (2024). ecommerce - weltweit. https://de.statista.com/outlook/emo/ecommerce/weltweit? currency=eur. Online; accessed 2024-02-29.

Sutinen, U.-M., Saarijärvi, H., and Yrjölä, M. (2022). Shop at your own risk? consumer activities in fashion e-commerce. *International Journal of Consumer Studies*, 46(4):1299–1318.

Yan, R. and Cao, Z. (2017). Product returns, asymmetric information, and firm performance. *International Journal of Production Economics*, 185:211–222.