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Artificial Intelligence Transforms the Fashion Industry for Circular Commerce

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The Fashion Waste Problem and Our Challenge

The fast fashion industry has a significant detrimental effect on the global environment. Of the estimated 150 billion garments that are produced every year, around 15 to 45 billion are never sold, causing massive waste problems.¹ Over 50 billion clothes are thrown away within a year after being manufactured,² adding up to 92 million tons of annual fashion waste.³

Meanwhile, the resale market for apparel, footwear, and accessories is worth an estimated 100 to 200 billion dollars worldwide, and demand is still on track for further growth.⁴ With the help of our challenge-giving organization, SAP, we wanted to support this trend and combat fashion waste by coming up with a concept that further boosts the resale fashion market. The challenge was to integrate artificial intelligence (AI)-driven analysis and algorithms into optimal pricing strategies for pre-owned fashion items and goods, considering relevant factors that affect the price, including customer preferences, market conditions, product specifics, and business-related issues.

This idea draws on the concept of circular economy and circular commerce. The term "circular commerce" represents a business model that seeks to establish a closed-loop system in which goods are created, manufactured, and used in a way that maximizes resource efficiency and reduces waste.⁵ In our challenge, we emphasize the potential of re-using and re-selling to build a more sustainable future that is also commercially feasible.

Our Process

The obvious first step for our group was to comprehend the challenge and intended outcome. It required us to include the levels of artificial intelligence (AI), data analysis, and commerce specifications in our work. We also had to contemplate how a circular fashion model could be devised in light of a circular economy. Before working on specific ideas, we needed to consider why and for whom we were developing this concept. In other words, we needed to figure out what our purpose was and what values we wanted to develop for a sustainable future. We were

able to accomplish this through exercises such as creating a stakeholder map and answering the *Why?*, *What?*, and *How?* questions.

We began delving deeper into the characteristics and economics of the fashion sector on the second day, as none of us had any prior experience in this field. After some study and input from our challenge giver, we found at least 20 criteria that influence the price of a pre-owned fashion item in the resale market (see Figure 1). We classified them into four broader groups: Customer preferences and trends; market conditions; product specifics; and business-related factors.

<p>Customer Preferences & Trends:</p> <p>Aesthetic Preferences Fashion Brand Perceived Value of the Item by Customer</p>	<p>Market Conditions:</p> <p>Fashion Trends Seasonality Macroeconomic Considerations (e.g., Inflation, Spending Levels) Prices of Competitors</p>
<p>Product Specifics:</p> <p>Quality of the Item Item Condition Price of new Item Item Type (e.g., Jacket, T-shirt, etc.) Material of the Item</p>	<p>Business-Related:</p> <p>Costs for cleaning Profit Margins Marketing and Advertising Costs Current Inventory Repair Costs Cleaning Costs Logistics Human Resources</p>

Figure 1: Comprehensive Factor List: What factors influence credit and final price?

On this basis, we wanted to discuss how to incorporate AI into the process of gathering data and analyzing how these aspects influence the price. This was especially difficult because we had to find a delicate balance between collecting massive amounts of data on trends, customer behavior, and other aspects while ensuring that our model was technically possible and had a commensurate energy demand.

On the third day, we received critical but helpful feedback on our idea from two professors. It highlighted that we had to emphasize more strongly why we need AI in our model or how

calculating the optimal price benefits the resale fashion market and contributes to sustainability. We utilized the final two days to outline how we would employ AI in our product.

Another round of feedback from our challenge giver and seminar hosts revealed that stressing the purpose of our business idea during our pitch and having a well-structured presentation would be critical. On the fifth day, we concluded our project week with a pitch night.

Our Project Idea



As a Munich-based business, our primary goal is to promote sustainable fashion and reduce fashion waste through the resale of pre-owned clothing. To accomplish this, we developed a strategy that not only rewards customers with optimal credit for their pre-owned fashion, but also ensures that these items are

resold at the best possible price.

The use of AI is central to our approach, which is required for navigating the complexities inherent in fashion resale, including seasonal fluctuations, trends, logistics, brand valuation, inventory management, and repair considerations (see Figure 1). Figures 2 and 3 depict our concept, which is based on two fictitious customers and our company acting as an intermediary.

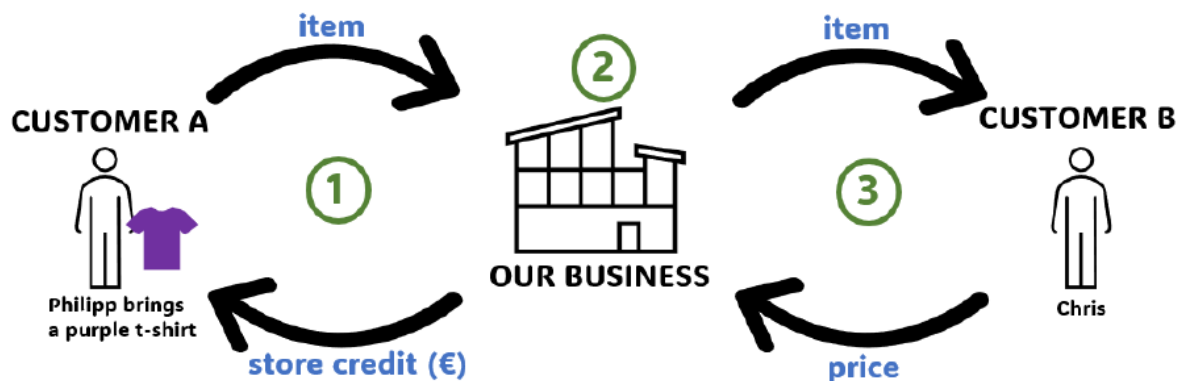


Figure 1: Customer A sells a fashion item to our business and receives optimal credit.

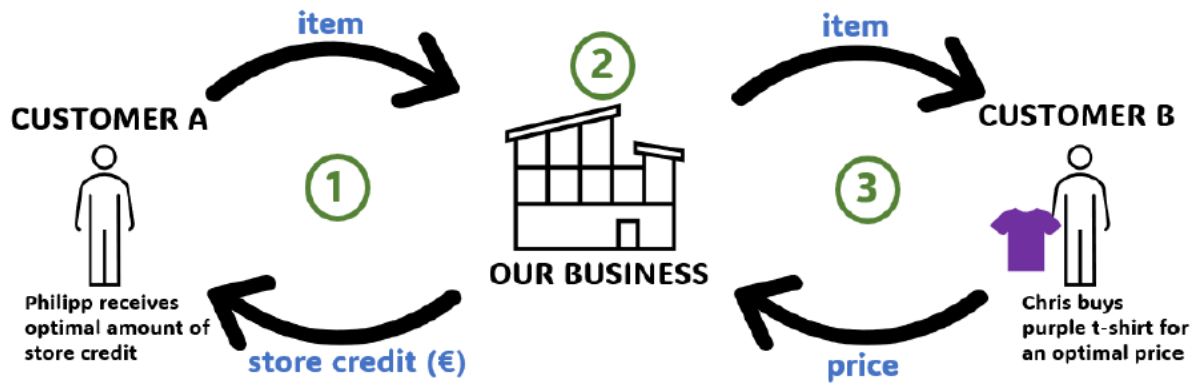


Figure 2: After necessary cleaning and, if needed, repairing processes within our business, we sell the item to a final customer B for an optimal price.

AI Integration for Optimal Resale

Our innovative fashion reselling prototype uses AI to enable precise pricing and fair crediting. Customers begin the process by uploading images and descriptions of the items they wish to sell. In this case, sophisticated computer vision and Natural Language Processing (NLP) models are used to extract and categorize important attributes like style, brand, size, fabric, color, and condition of the item (see Figure 4). These AI-powered algorithms are trained on massive datasets of fashion images and descriptions (e.g., ACS)⁶, outperforming humans in terms of analysis speed and accuracy.

Pricing Strategy

These extracted attributes are fed into an advanced AI pricing model, which improves obtaining current resale market data that is difficult and time-consuming to extract manually. To determine the most equitable and profitable price for both sellers and buyers, the AI model carefully evaluates various factors depicted in Figure 1, including fashion trends, evolving customer preferences, competitor pricing, our current inventory, product specifics and conditions, and additional costs for cleaning and repairing. Essentially, our platform adjusts prices dynamically, ensuring maximum value from used fashion items while reducing waste.

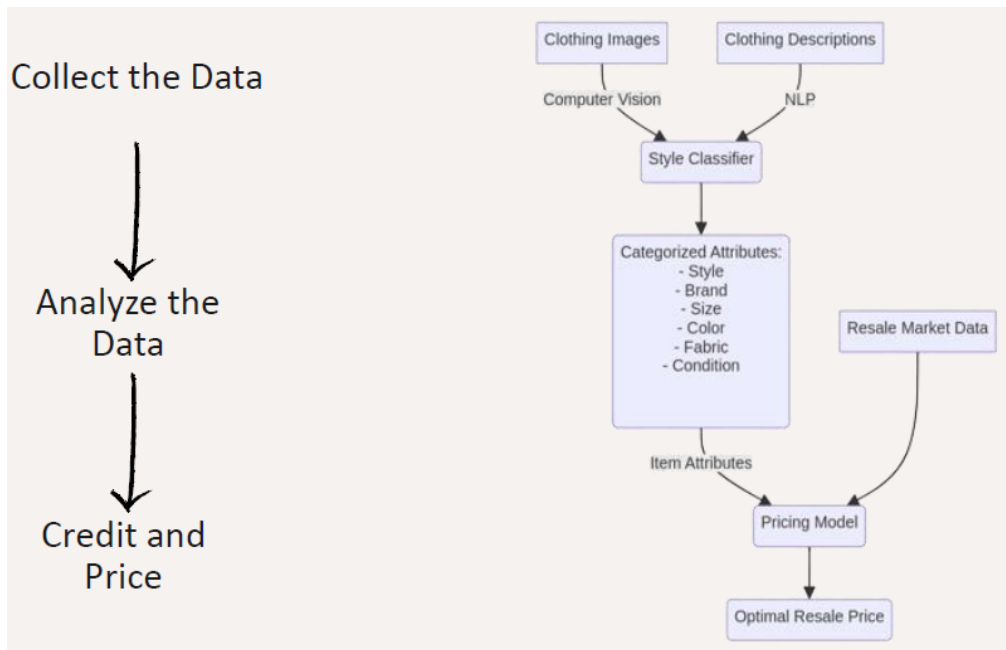


Figure 4: AI Integration Visualization for Optimal Resale

Impact and Advantages

Our idea transforms the fashion resale landscape by efficiently assessing items and dynamically pricing them to capture their true residual value. This approach not only benefits sellers by providing fair compensation for their item but also appeals to buyers looking for pre-owned fashion at reasonable prices. Furthermore, incorporating AI in this case reduces human bias, improves inventory management, and accurately predicts demand, resulting in a strong ecosystem for sustainable fashion resale.

Project Outlook

Collaboration with other brands could be a strategy for growth and impact as we advance our sustainable fashion enterprise. We understand how critical it is to keep our AI models transparent, understandable, and accountable, especially when collaborating with other brands. Obtaining complete transparency may appear difficult given the complexity of deep learning algorithms used for pricing, categorization, and trend analysis. Our commitment to transparency increases trust and credibility but also aligns with our commitment to ethical and responsible business practices.

Furthermore, transparency in our AI model is linked to ethical concerns. We aim to build trust among our collaborators and users by openly communicating our ethical guidelines and the principles that guide our AI's decision-making process.

Ecological Sustainability

Given the large amount of data required to train and adjust our model, we must ensure that the computational power and energy consumption remain appropriate and do not tip our application's sustainability balance to the negative side.

References

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- ⁶ For a list of fashion databases our AI may obtain data from, see Goti, Aitor, Leire Querejeta-Lomas, Aitor Almeida, José G. de La Puerta, and Diego López-de-Ipiña. “Artificial Intelligence in Business-to-Customer Fashion Retail: A Literature Review.” *Mathematics* 11, no. 2943 (2023).