Green E-Commerce

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***Abstract*— At present, the e-commerce sector is characterised by rapidly increasing volumes of parcel deliveries, causing congestion, noise and air pollution in public spaces. The number of CEPs is also increasing due to more partial deliveries, multiple delivery attempts and a high number of returns. According to the "eCommerce Study Austria", the return rate for the year 2020 will be over 40 percent. Increased freight transport on the last mile will lead to more congestion, noise and emissions. On the demand side, online shops often offer no or only very limited climate-friendly delivery options, which contradicts the growing sustainability awareness of many end customers. The design, development and evaluation of technological, behavioural and logistical interventions will address these gaps. The Green eCommerce project aims to enable online customers to make their deliveries more sustainable and to increase their awareness of sustainable goods transport through technological (AI-based chatbot, 3D fitting tool), behavioural (playful reward system, persuasive design patterns) and logistical (choice of e-transport) innovations. In particular, the aim is to minimise returns and multiple home delivery attempts, and to encourage bulk ordering and direct delivery of regional products. The extension of existing online shops with these innovative and modular components represents a novelty in the sense that traffic avoidance, traffic optimisation and modal shift can be achieved through the behaviour of online customers. Compared to current measures in freight logistics (e.g. route optimisation, electrification of the fleet, construction of hubs), this persuasive approach aimed at the end consumer has hardly been researched. This package of measures is currently being implemented in three online shops and evaluated in terms of acceptance, usability and environmental impact.**

Keywords*— *ecommerce, gamification, persuasive design, nudging, chatbots

I. INTRODUCTION

Nationally, the e-commerce sector is experiencing unabated sales growth, with spending set to reach a new record of €9.6 billion in 2021 [1]. The Covid-19 pandemic has intensified this boom, leading to a 9% increase in the share of customers buying online in 2020 [2]. This will be accompanied by a 16.7% increase in parcel volumes in 2020, corresponding to 287.1 million parcels shipped in the B2C sector. This will be driven by an increase in online orders, as well as partial deliveries and strong growth in returns [3]. By 2020, almost one in four parcels shipped will be a return [3][1]. The increase in last-mile freight transport will lead to an increase in congestion, traffic noise and emissions. On the demand side, the situation is aggravated by the fact that consumers are often not offered any or only very limited climate-friendly delivery options in online shops, which contradicts the growing sustainability awareness [4].

The industrial research project "Think!First" [5][6], in which some of the consortium partners have already participated, tested behavioural interventions in online shops. Initial results indicate that behavioural interventions have a positive effect on changing the awareness and behaviour of online shoppers. These promising results will be deepened in Green eCommerce and extended by innovative technological (e.g. AI-based chat bots, sizing tools) and logistical interventions (e.g. selection of climate-friendly delivery options). By involving renowned online shop operators as well as a delivery service provider, several months of practical testing can take place in real operations for different objectives. The entire ordering and delivery process between online shop operators, online customers and delivery service providers will be analysed and evaluated. This preventative and demand-driven research approach provides both new and in-depth insights. The central question is whether online customers can be made aware of sustainable transport directly during the purchasing process and motivated to choose it more often through innovative interventions in online shops. Green eCommerce thus ties in with the growing trend of increased awareness of environmental and climate protection among end consumers [7].

II. PROMOTION OF INNOVATIVE ADDONS FOR ONLINE STORES

The high number of 5.7 million online shoppers (representing 75% of the Austrian population) illustrates the importance of e-commerce in Austria. Clothing and textiles, with a return rate of up to 47% [1], are particularly popular, accounting for 45% of online purchases in Austria [1], with the Corona crisis in 2020 leading to a shift in spending towards food and luxury goods (+46%) and drugstore and cosmetics (+34%) [8].

However, these developments are accompanied by changes in CEP transport performance due to increased parcel volumes in the B2C sector, with all the negative consequences that this entails. Consumer-oriented optimisation of online shops therefore appears to be a key lever for avoiding, shifting and optimising traffic on the last mile. Only under optimal conditions (e.g. low returns, high use of climate-friendly transport, purchase of regional products) online shopping has the potential to be a better choice than stationary shopping [9] [10] [11].

Unfortunately, it can be observed that many delivery service providers do not seize the opportunity to redesign their delivery processes in a new and sustainable way, despite technological possibilities and political incentives. The main reason for this could be that the massive competition with a focus on delivery time and parcel volume (due to low margins on the last mile) is too strongly anchored in the companies. This makes it all the more important to address the demand side of online customers through innovative behavioural and technological add-ons. Online shopping is only more CO2-friendly than stationary shopping under optimal conditions. In order to make e-commerce logistics more sustainable, we want to offer the following technological and behavioural innovations as add-ons in a unique combination to existing shop systems.

A. TECHNOLOGICAL ADDONS

Currently, only a few online shops offer fitting tools for automatic measurement of dress sizes and virtual try-on. However, returns and unnecessary orders are driven by clothes in inappropriate sizes, subjective dislike of the cut/colour/size and lack of ability to try on clothes online [5] [6]. Currently, with the exception of eyewear providers, H&M and Amazon Fashion as big players, there is neither a system that can be used as an easy-to-install add-on for a shop operator nor a system that can be used for many different types of clothing. We are therefore planning to develop a system that 1) can be easily installed by the shop operator, 2) does not require any physical presence in the shop or special hardware (except possibly a depth camera on a mobile phone) and 3) does not require any elaborate 3D models of the clothing with regard to the backend, but works just as well with digitally cut-out 2D garments. In addition, an automatic measurement of different clothing sizes is planned if data is available (e.g. height, waist circumference, chest circumference, head circumference, shoe size). After a technical feasibility analysis, either mobile phones with depth cameras or normal mobile phone front cameras as well as notebooks with webcams will be used for this.

- Creation of an AI-supported chatbot to highlight regional products and sustainable delivery options: Commonly used chatbots are trained using end-to-end deep learning from dialogue-based sources and usually answer "frequently asked questions" from customers. In this project, we are developing a "nudging" bot that proactively intervenes when it becomes apparent that the user is unsure about the selection of sustainable ordering options. For this we will use more complex language models on the one hand, but on the other hand we will also use training materials on sustainability as data sources.

B. BEHAVIORAL ADDONS

Creation of informative and reflexive nudges to specifically influence the behaviour of online shop customers: In combination with the semantic intelligence of the chatbot, the designed nudges should lead to a higher acceptance of suggestions that might be perceived as disadvantageous (e.g. longer delivery time, smaller selection of local products with short distances). Currently used bots or "digital agents" only aim at improving the user experience and reducing the costs for customer relations on the basis of automation.

- Use a gamified loyalty system to increase customer compliance: Implement a points/exchange system for earned incentives to reward sustainable purchasing decisions (e.g. collection pass for kept products, choice of sustainable delivery options, purchase of a product in one size only). Current loyalty approaches reward regular shopping and do not target resource and climate-friendly loading and delivery.

- Integration of persuasive design approaches in shop interfaces to specifically highlight regional products with short distances: Products with a low CO2 footprint in relation to delivery should be made more easily accessible to customers by means of filter options and colour coding. In addition, further decisions, such as collective orders, can be controlled through the conscious design of delivery options.

III. CASE STUDY "GREEN ECOMMERCE"

The overall objective of Green eCommerce is to design, develop and evaluate innovative technological, behavioural and logistical add-ons. These add-ons will extend existing online shops with the aim of avoiding, shifting and optimising traffic on the last mile. In addition, the implemented add-ons and their behaviour-changing effects will be validated in a series of practical tests with different objectives, shoppers and product groups in the respective test environments.

As a result, modular add-ons for the expansion of existing online shops are available, which are based on

1. logistical (e.g. e-transport, collective orders, direct delivery from regional producers),
2. technology-driven (e.g. AI-supported chatbots and fitting tools for virtual try-on) and
3. behaviour-based interventions (e.g. gamified loyalty system to support the customer). gamified loyalty system to underpin 'climate-friendly' or desirable behaviour & reward via discount schemes; persuasive design and nudging strategies to convey subtle cues/information to voluntarily push for sustainable fitting and delivery options).

- In addition, the project pursues the following project-specific sub-goals:
  - Contextual requirements analysis and target definition involving online shop operators, online customers and CEP service providers in the sense of a co-creation approach.
  - Modular design and development of individual add-ons using open source solutions to network the current state of the art and achieve synergies and easy transferability.
  - Empirically based processing of the results of the test runs lasting several months and in-depth research into the impact mechanisms between customer-oriented forms of intervention and effects on transport (e.g. reduction of CO2, returns, transport performance; increase in capacity utilisation, purchase of regional products).
  - Detailed preparation for implementation and commercial exploitation by examining the practical feasibility, suitability and transferability of the developed add-ons in the context of the planned practical tests by outlining possible implementation paths, go-to-market strategies and business cases.

This customer-centric approach starts with the delivery process to minimise returns and multiple home delivery

attempts, to bundle orders and to encourage direct delivery of regional products as well as the selection of climate-friendly transport options (see figure 1).

The research methodology relies on a multi-dimensional approach involving qualitative indicators such as focus groups and quantitative indicators such as a survey on the subjective behavioral impact of the implemented add-ons. The results will be presented at a later time.

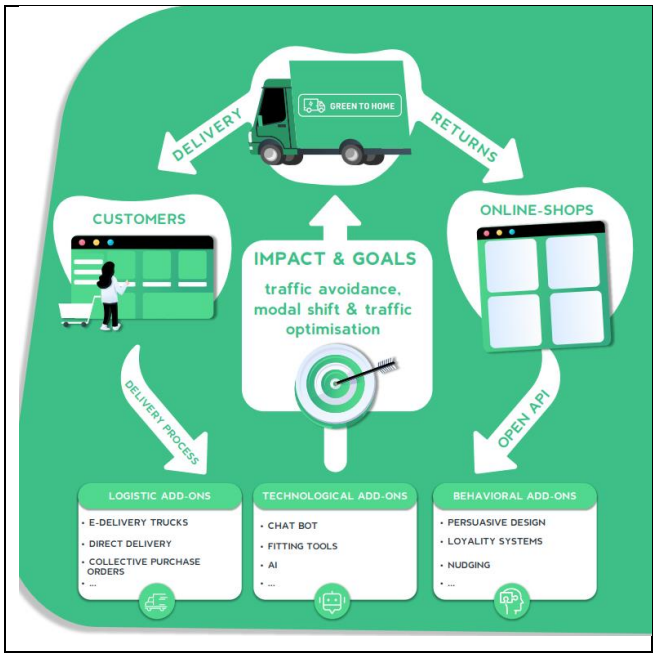

Fig. 1. Project framework

A. *EXEMPLARY IMPLEMENTATION OF LOGISTICAL, ADDONS*

Fig. 2. Logistical innovation: pre-selection of e-truck delivery "Environemtally friendly delivery via Green To Home"

After a one-time registration with the logistics partner "Green To Home", the option "Environmentally friendly delivery via Green To Home" is selected as the default setting (see figure 2). The parcel is then delivered by an e-delivery van and the CO2 savings can be viewed on a dashboard on the company's website.

B. *EXEMPLARY IMPLEMENTATION OF TECHNOLOGICAL ADDONS*

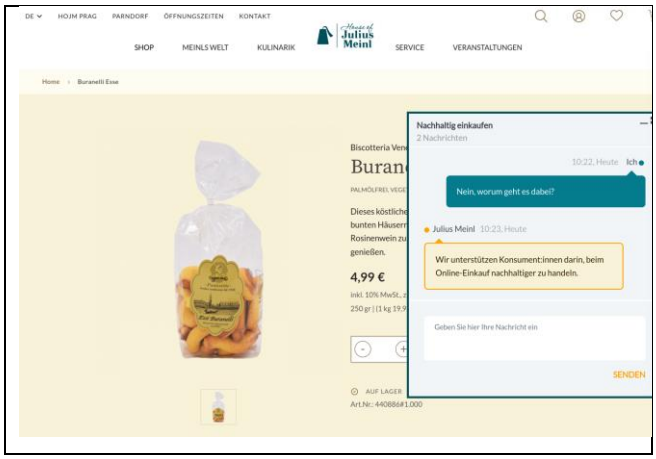

Fig. 3. Technological innovation: AI enhanced chatbot presenting answers to questions around sustainable logistics

The AI enhanced chatbot engages users in dialogues about sustainably logistics in the ecommerce sector. Regarding the framework, the most complex variant of a dialogue system with the approximate effort of a first-order conversational bot was implemented by integrating ChatGPT 4.0 from OpenAI. A JavaScript module provides the necessary web components for integration into other shop websites.

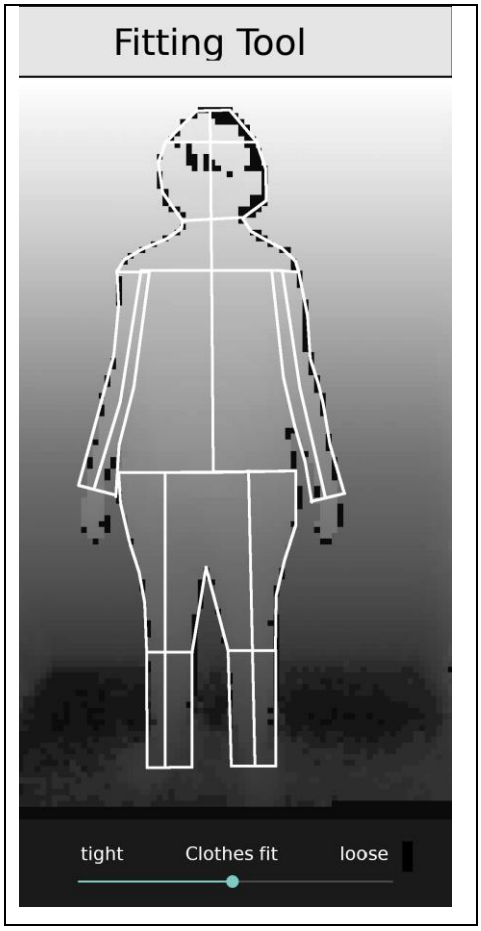

Fig. 4. "Fitting Tool" application

"Fitting Tool" (see figure 4) is an Android app that runs on special mobile phones with depth with depth cameras. It captures depth and colour image data of the of the person to be measured, which is then used to calculate precise sizes at various at various easily identifiable points on the body (e.g. waist, chest, forearm, ankle and arm, ankle and knee). To compensate for loose clothing during measurement, it is possible to reduce the calculated outline by a user-defined factor. by a user definable factor. The final version of the app will allow you to view depth and colour images at the same time. and colour image at the same time to allow the user to better assess the quality of the of the measurements by the user. It is intended for use by two people.

The chatbot has been trained using a customised prompt based on reference questions and answers provided by each partner. We tested different different ways of creating the test prompts described elsewhere [13] and selected the one that that gave the best performance according to each partner's partners' ratings.

C. EXEMPLARY IMPLEMENTATION OF BEHAVARIOAL ADDONS

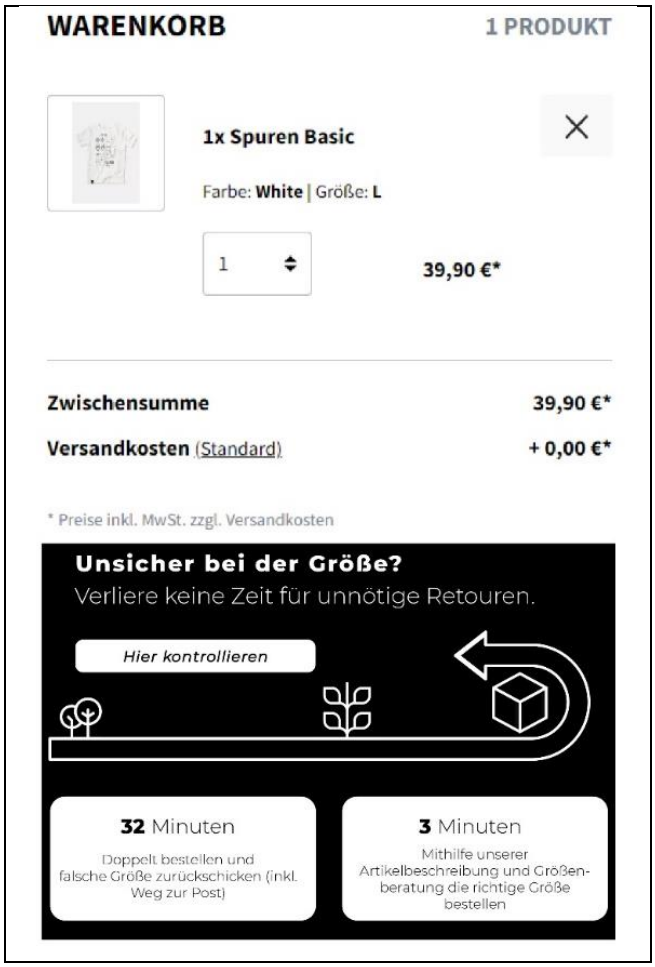

Fig. 5. Behavioral innovation I: nudge to create a sense of loss aversion due to the time needed to process a returned parcel (32 minutes)

Below the shopping basket is an information box with persuasive text elements focusing on the time lost when returning a product. The presentation of a real loss of time of 32 minutes on average due to an imprudent order or a resulting return is intended to encourage people to rethink. Loss aversion describes the fact that people attach greater importance to losses than to gains (see figure 5).

Fig. 6. Behavioral innovation II: nudge to create a sense of social pressure to use services such as the digital sizing advice

This nudge shows that many other shoppers are already behaving sustainably by avoiding returns, and motivates shoppers to contribute to climate protection by communicating this social norm, in terms of reading product descriptions carefully and using digital sizing advice (see Figure 6).

Fig. 7. Behavioral innovation III: Serious Game

As part of the behaviour-based add-ons, a serious game (see figure 7) was developed that allows visitors to try out key measures from the project in a compact time window. On the one hand, the visitor experiences in the game which logistical measures (e.g. group orders) can be used to make freight transport more sustainable. On the other hand, the game offers the opportunity to discuss relevant topics with the project staff as a game character, so that the visitor can learn more about gamified reward systems, nudges and returns.

IV. EXPECTED IMPACT

Reducing the volume of traffic and the performance on the last mile, e.g. by minimising returns, increasing vehicle utilisation through collective orders, longer delivery times, direct and short home deliveries from regional producers, leads to a relief of today's often overloaded transport infrastructures, but also to an improved quality of stay in urban public spaces. Initial results from "Think!First" show that AI-supported sizing combined with persuasive design can reduce the return rate in the clothing sector by around 11% [6]. In particular, the addition of the 3D fitting tool should reduce returns even further. The effect that minimising returns would have is illustrated by the following - rather conservative - estimate:

- In 2020, approximately every fourth parcel shipment in online retailing was returned → approx. 46.1 million returns [3].

- CO2 pollution: 27,660 tonnes per year due to returns, per return 600 grams of CO2 [12] = CO2 savings: 2,766 tonnes per year (annual reduction of returns by 10% due to the implemented addons).

V. CONCLUSION

In this case study we presented a gamified loyalty system that rewards users for high compliance, persuasive design principles that visually highlight regional products with short delivery routes or collective orders, as well as AI-supported fitting tools and chat bots that automatically measure clothing sizes and point out environmentally friendly delivery options, customers are encouraged to shop more consciously - in the sense of more sustainable freight transport.

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