

r p s s f l r d r p l g f l f a d s d f n d l for e-grocery deliveries

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Abstract: In recent years, the continuous rise in packaging waste has been primarily attributed to the growing popularity of e-commerce. Currently hardly any reusable or circular packaging schemes have been implemented in Austrian e-commerce operations. The reason is mostly because there is no cost-effective way to realize reusable packaging as handling are critical to the profitability of the packaging scheme. To address this circumstance and potentially promote the further implementation of circular packaging, the aim of this paper is to present a new circular packaging technology which is based on automatized and modular packaging units. For the success of such a new packaging technology, consumers have a critical influence. Therefore, a survey is conducted e-grocery deliveries. The delivery of deep-frozen bakery products will be taken as a use case to study the acceptance of circular packaging. Consumers are aware of the sustainability problems bound up with packaging waste. Consumers attach a very high importance to sustainable packaging. However, the survey results also show that consumers are rather convenient. They appreciate personal delivery service and only a small number of survey participants are open to using new delivery concepts.

Keywords: Reusable packaging, green packaging, parcel delivery, circular economy, consumer preferences, e-commerce.

Conference Topic(s): autonomous systems and logistics operations (robotic process automation, autonomous transport/drones/AGVs/swarms) business models & use cases; Modularization; omnichannel & e-commerce logistics; PI implementation.

Physical Internet Roadmap: ☒ PI Nodes, ☐ PI Networks, ☐ System of Logistics Networks, ☐ Access and Adoption, ☐ Governance.

1 Introduction and motivation

In online retailing, logistics constitutes a central economic function, regardless of the sector. Increased use of online grocery shopping has been noticed in recent years: An above-average growth was recorded in the course of the pandemic and is predicted to continue. The delivery of online groceries poses particularly high requirements on logistics due to the necessity of handling temperature-sensitive goods (Lagorio and Pinto, 2021; Zissis et al., 2018). The emitted greenhouse gas emissions and resource consumption caused by logistics are increasingly moving into the focus of consumers (Rausch et al. 2021; Boz et al. 2020). While packaging waste has risen continuously in recent years, a lack of sustainable alternatives for e-commerce

can be witnessed. The paper addresses this gap and presents an option for reusable e-commerce packaging which is in line with the fundamental principles of the Physical Internet (Montreuil, 2011). We will present a new circular packaging technology which is based on automatized and modular packaging units. For the success of such a new packaging technology, consumers have

circular packaging for e-grocery deliveries.

To evaluate the urgency of the problem at hand, an analysis of the development of e-commerce in Austria was conducted beforehand. The development of e-commerce can be seen as a key driver of parcel logistics. The analysis clearly shows that the online share of retail spending in Austria has been rising steadily since 2017 and already reached a share of 14 percent of all spendings by 2022. (Statista, 2023) Moreover, experts expect shares to rise to 23 per cent within the next few years (McKinsey, 2023).

Consumers increasingly demand higher sustainability in parcel logistics. Recently conducted surveys indicate that up to 79 per cent of consumers consider sustainability as being important for e-commerce, representing a major increase compared to past surveys (CGS, 2022). In addition to the increase in relative and absolute figures, further challenges for parcel logistics can also be identified. 92 percent of consumers consider the availability of free delivery to be important; 42 percent of survey participants rate the option of same day delivery as important.

In a customer experience study conducted by BOOXit, 82 percent of consumers stated that the sustainability of parcel delivery is very important or important to them. In addition, other important factors can be defined from the consumer's point of view; the efficiency in processing is just as important as the cost efficiency of delivery and/or return processing (BOOXit Customer Experience Study, 2022)

As mentioned above, consumers rate the possibility of free delivery and return as being pivotal while simultaneously demanding fast, flexible and sustainable delivery (Nguyen, 2019). This field of tension creates a need for increased automation and cost efficiency in logistics processes.

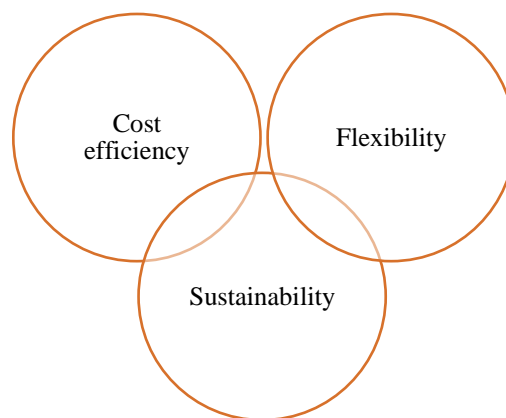


Figure 1: Current field of tension in parcel logistics

2 Objectives of automated circular packaging

BOOXit (BOOXit, 2023) addresses the key factors of cost efficiency, flexibility and digitalization as well as sustainability.

To increase process efficiency and thereby reduce process costs, the automated circular packaging approach is used. The term of automated circular packaging refers to reusable packaging which can be handled automatically by robots thereby reducing process costs which are, among others, caused by human errors. Further technological aspects foster the mentioned decrease in costs providing comparative advantages, i.e. automatized loading of boxes, AI-based route optimization and reduction of picking time using the pick-by-light-approach.

In addition to the increased efficiency that results in reduced costs, the issue of flexibility and digitalization is also well-addressed by this system. BOOXit implemented digital connectivity in their system. Using an app, consumers are not only given the opportunity to track their delivery in real-time but are also enabled to manage returns easily by simply scanning the code on the box.

BOOXit based on latest technology advancements such as CP33-level communication for Industry 4.0 or the implementation of Blockchain technology to safely track processes. Connecting all relevant components, such as delivery boxes, shelves and the app to each other using a centralized database ensures maximum transparency for all stakeholders.

Lastly, the increasing demand for more sustainability along supply chains is fulfilled by using circular packaging thereby reducing packaging waste. Boxes are available in several dimensions using a grid system based on the palette measures of 120 x 80 centimeters. Twelve different box sizes cover approximately 82 per cent of box sizes currently used for delivery. According to the company, the amount of CO₂, which is currently emitted during parcel delivery processes, can be reduced by 92 per cent using circular packaging systems. Moreover, an increase in resource efficiency can be witnessed as cardboards are no longer needed and thereby saving further resources such as timber and water.

3 Methodology and case description

Referring to the challenges of parcel logistics in general, it must be noted that the specialized field of grocery logistics must fulfill further consumer demands in terms of delivery. First and foremost, goods are often temperature-sensitive and therefore require constant cooling throughout the whole delivery process in order to maintain product quality. To meet these requirements, the packaging technology BOOXit cooling and is therefore well suited to transport temperature-controlled goods such as e-groceries.

3.1 Use case description

The delivery of deep-frozen bakery products will be taken as a use case to study the acceptance of circular packaging. Austrian consumers are well used to being delivered with deep-frozen bakery products. The delivery of deep-frozen bakery products already dates back to the time before the e-commerce business accelerated and many consumers already have a lot of experience ordering deep-frozen bakery products. We therefore consider this as an appropriate field to introduce a new innovation such as automated circular packaging.

Robots allow for the (automated) loading and unloading of the parcel delivery vehicles, so that ideally a package only needs to be handled by the recipient at the destination, and not by postal

employees in the distribution centers. For this purpose, the start-up BOOXit developed modular boxes which can be gripped by a robot gripper arm and loaded into a trolley. This trolley can then either be pushed manually into the delivery vehicle by an employee, or automatically be lifted into the vehicle (which is also equipped accordingly with the aid of transport rails mounted overhead).

operations, i.e. multiple packages can be handled at the same time, reducing the amount of handling time and costs. The modular design is in line with the fundamental considerations for containers in the Physical Internet (Landschützer et al., 2015).

For delivering the parcels, the postman can take individual packages out of the trolley and hand them over at the doorstep of the consumer. A pick-by-light system supports the postman in quickly finding the right parcel. Another option is to place the trolley containing the packaging at a public space and use it as a parcel locker. The parcel locker functions as an automated postal box that allows users for a self-service collection of their parcels as well as the dispatch of parcels or return of empty packaging.

3.2 Survey description

For the success of such a new packaging technology, consumers have a critical influence. It is the responsibility of the consumers to use and return the circular packaging without this survey is -grocery deliveries. It will be assessed what preferences they have regarding the delivery of e-groceries conducting a consumer survey.

An online survey has been conducted to evaluate what preferences the customers of deep-frozen bakery products have regarding the use of an automated circular packaging system as described above. In particular, it will be examined which delivery options consumers prefer being directly delivered at home or picking up the delivery at a parcel locker or at a local store, and which framework conditions must be given for each of these options.

The invitation to the online survey was sent to 43,067 customers of a deep-frozen bakery retailer. To provide an incentive for participation in the survey, a lottery was offered for the respondents. In the end, 2,283 consumers completed the survey. The survey was conducted in May 2022.

4 Results

4.1 Consumers' perspective in terms of cost efficiency

81 per cent of survey participants stated that a free delivery is very important, further 14 per cent considered this aspect important (n= 2123). These figures are also supported by other recently conducted surveys. For instance, the latest e-commerce dossier compiled by statista.de (2022).

s of delivery, such as Click and Collect, drive-in-solutions, pick-up stations or unsupervised home-delivery, the conducted survey provides a diverse picture. On use such facilities for last-mile-participants are more open to these new approaches than more experienced consumers (Figure 2).

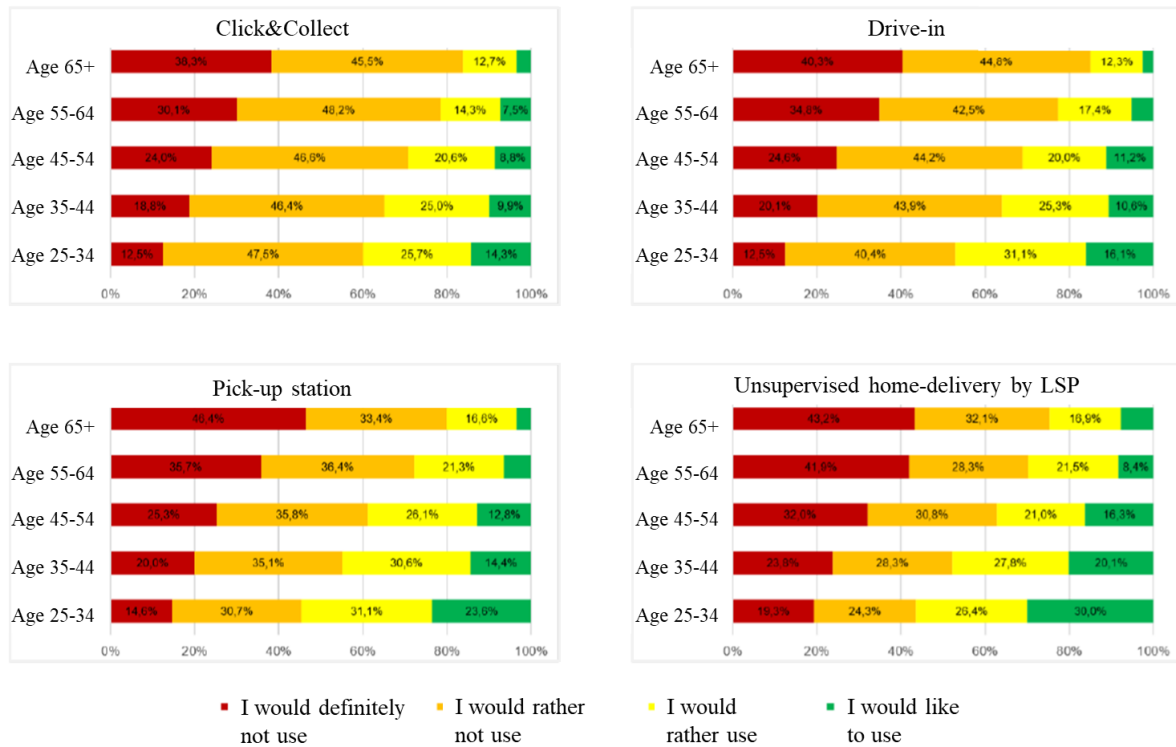


Figure 2: Acceptance of last mile delivery options (n=2,283 consumers)

On the other hand, willingness to pay for the above-mentioned approaches is generally low (Figure 3)

- up stations (78.9

address can be noted as being vital for last-mile-delivery, yet 56,8 per cent of surveyed consumers would still not accept additional costs for home-delivery provided by a logistics service provider.

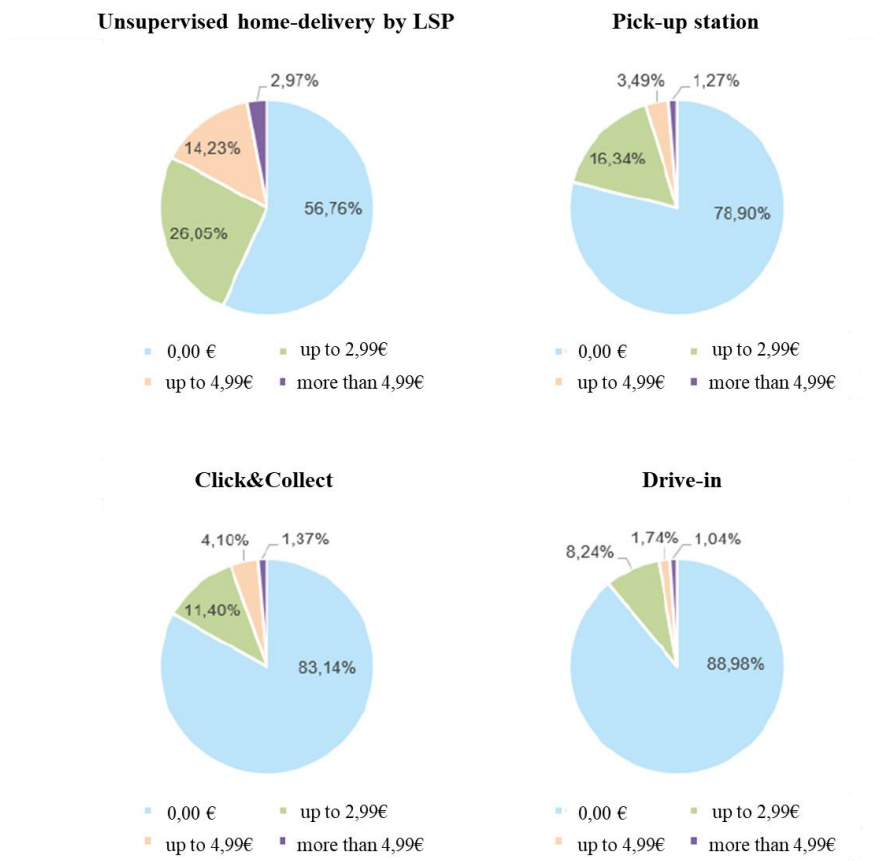


Figure 3: Willingness to pay for last mile delivery options (n=2,283 consumers)

4.2 Consumers' perspective in terms of flexibility

The results showed that younger generations are more open to new delivery alternatives, so that the potential for using BOOXit as a parcel locker station should be given among younger customer groups. Those consumers who are willing to pick up their parcel would accept a detour of up to three kilometers. The older the survey participants, the less willing they were to make a detour for picking up a delivery. Throughout the survey, participants were also asked how they would arrive at the parcel locker (Figure 4): Only a small percentage (3.6 per cent) would use public transportation for pickup. 84 per cent of respondents indicated that they would use the pick-up service in the course of their way home (e.g. from work or in combination with other shopping activities). 21.5 per cent of the surveyed customers would be willing to pick up the goods on foot or by bicycle. Approximately one fifth of respondents (21.1 per cent) would accept an additional car journey for the self-collection service, which is the least sustainable way to realize self-pickup.

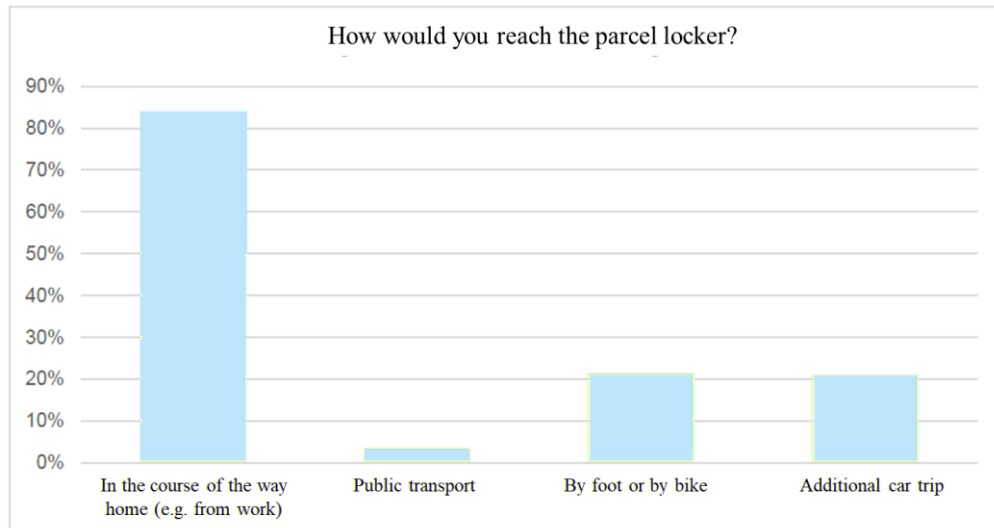


Figure 4: Arriving the parcel locker (n=2,283 consumers)

As it can be seen openness to alternative delivery options is still low, especially smaller households (i.e. a maximum of two residents) prefer receiving their orders directly and consider this as being very important (51.9 per cent) or at least important (54.8 per cent). Furthermore, the survey shows that flexibility in terms of timeframe for delivery is also important to customers. The majority of survey participants state that intimating a preferred timeframe for delivery is very important to them, further 21.2 percent responded with important. Surprisingly, the availability of timeframes for delivery in the evening hours is less important to customers. Almost two thirds of the surveyed customers see this option as being either less important (31.3 per cent) or even unimportant (34.6).

4.3 Consumers' perspective in terms of sustainability

Consumers are well aware of the sustainability problems bound up with packaging waste. Some consumers are even prevented from ordering e-groceries because of the packaging waste. Consumers attach a very high importance to sustainable packaging. They state that they would prefer those retailers which offer sustainable packaging options. However, the survey results also show that consumers are rather convenient. They appreciate personal delivery service and only a small number of survey participants are open to using new delivery concepts.

The conducted survey clearly shows the paramount importance of circular packaging, with almost 91 percent of the participants considering sustainable packaging very important (61 percent) or important (30 percent) yet both genders replied differently as female participants consider sustainably packaging as being more important (92.1 per cent) than males (85.7 per cent). Another s BOOXit per cent consider circular packaging to be more sustainable than cardboard, thereby addressing the issue of sustainability in parcel logistics (BOOXit, 2022).

Besides the issue of packaging, 54 per cent of the survey participants consider ecological delivery (e.g. by using e-cars) to be very important or important. This result aligns with -emissions.

5 Conclusion and outlook

sustainability in e-grocery delivery is currently rising following the zeitgeist. The COVID-19 pandemic served as an accelerator to a observable increase in e-commerce acceptance among consumers thereby leading to an increase in packaging waste. Moreover, customers are not willing to lower their demands in terms of flexibility and cost-efficiency creating a field of tension for logistics providers.

Circular packaging in combination with digitalization and process automation addresses this field of tension by reducing handling costs through automation while simultaneously fulfilling customer demands in terms of sustainability as packaging waste can be dramatically reduced.

Even though a small number of consumers is already willing to use alternative forms of last-mile-delivery, convenience among customers is still widely spread. Receiving the ordered items directly still represents the most appreciated form of delivery. Moreover, it can be said that customers are generally not willing to pay extra fees for circular packaging. It can therefore be derived that suppliers must carry possible extra costs for circular packaging yet following this approach holds the potential of creating a comparative advantage.

Therefore, creating a sustainable, flexible, and cost-efficient approach to circular packaging is paramount in achieving customer satisfaction and should be implemented to meet the growing demand for e-commerce.

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