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CRITICAL PROCESSES AND RISK FACTORS OF DISTURBANCES IN THE IMPLEMENTATION OF ECOLOGICAL REUSABLE PACKAGING INTO CONTEXT OF E-COMMERCE SUSTAINABLE DEVELOPMENT

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ABSTRACT: The aim of the article is to identify critical processes in the context of the implementation of returnable packaging in e-commerce and potential risk factors of disruptions in the use of ecological reusable packaging in e-commerce logistics services provided by Arvato Poland Sp. z o.o. they are based in Warsaw. The study is in line with the objectives of the European Green Deal and the circular economy. The applied research methods and techniques included: elementary analysis, desk research analysis, in-depth face-to-face interviews, causal analysis and selected methods of qualitative and quantitative analysis. The empirical study was carried out in 2021 in two locations of Arvato Poland Sp. z o.o. A review of the literature on the subject indicates that the use of ecological returnable packaging in e-commerce logistics is one of the available solutions with great potential to strengthen the sustainable development of the fashion industry. However, the conducted research revealed a high complexity of problems, mainly in the process of accepting, packing, shipping and returning the packaging, which was considered critical for handling e-commerce orders. An in-depth analysis using the Ishikawa diagram identified the causes of potential risk factors for disruptions in the use of reusable eco-packaging in the e-commerce market. It was indicated that improving the process of its implementation should focus on removing factors that make up the identified main categories of their causes. The conclusions of the study can have practical applications to improve the functioning of cost-effective and environmentally friendly e-commerce logistics. The system approach used by the authors in the study of returnable unit packaging in the sustainable development of closed-loop e-commerce contributes to the reduction of the research gap in this thematic area. The issue of ecological reusable packaging is in the initial phase of cognitive research and pilot tests.

KEYWORDS: e-commerce, ecological packaging, sustainable development

Introduction

The dynamism and uncertainty of the environment affect the constantly growing requirements in the social, environmental and economic dimensions that are imposed on organisations. An inherent condition for maintaining the market position and development is a change that is permanently embedded in the culture of the organisation (Sharma et al., 2020). The need to efficiently implement changes and respond to disruptions determines the improvement of business process management methods. Modelling processes allows for the practical introduction of changes in an effective and purposeful manner and also enables quick reaction and adaptation to other factors that are unpredictable nowadays (Singh et al., 2019). Due to the significant role of e-business, modelling processes in accordance with the principles of sustainable development, in particular processes related to the functioning of the e-commerce market, is more and more often the subject of cognitive, methodological and empirical research (Sun et al., 2021; Sullivan & Kim, 2018; Guo et al., 2020; Bourlakis et al., 2018).

With the increasing number of major disruptions and the impact of the COVID-19 pandemic on the functioning of supply chains and the development of e-commerce, the pursuit of increasing sustainability has become a strategic imperative for chain organisations (DHL White Paper, 2022). At the heart of the multi-dimensional transformation is the belief that building a sustainable[1], circular e-commerce model with reusable eco-friendly packaging is a way to stay ahead of the competition. At the same time, pressure to reduce costs remains high, as customers expect competitive prices and company managements expect certain margins. The challenge for leaders and their organisations in the field of e-commerce logistics services is to work out new compromises between costs and an increase in the sustainability and resilience of chains in a turbulent environment, the key feature of which is increasing customer expectations. An important issue with reusable packaging is to find a balance between price and packaging waste and emissions from packaging in the context of disposable shipping packaging, including compostability and recyclability. In the analysed case, ecological reusable packaging that is the subject of the study is to be designed and made of recyclable materials and in such a technology that guarantees their multiple uses. It was assumed that the minimum, economically justified number of uses of the packaging in e-commerce service is to be 4-5 times.

[1] The phrase "ecological reusable packaging" used in the article refers to returnable unit shipping packages (reusable external transport packaging), which are functional and economical and leave the smallest possible environmental footprint.

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Ecological mail-order packaging in e-commerce is of key importance due to its range of applications and environmental impact, including climate change. They serve, among others, for securing goods during transport and storage, easier identification and an efficient handling process (Korzeniowski et al., 2012). From the perspective of increasing product flows in supply chains, they should contribute to closing the loop and reducing waste. For the customer, the main function of packaging is to ensure that the goods reach the buyer without damage and that they will serve them as intended. One of the most important features of the e-commerce logistics service is its reliability. It is achieved by proper planning of the process and then ensuring that its course takes place in accordance with the developed operation plan and adopted procedures. As research shows (RePack Blog, 2022), most problems arise in the design and preparation phase of packaging and in the planning of the implementation of these packaging as part of electronic distribution channels. Detecting potential causes of nonconformities early in the life cycle (LCA) can help avoid adverse events. It is estimated that about 20% of online returns are caused by damage to goods. Often the cause of such damage is improperly packed or inadequately protected goods. At the same time, a well-designed system of reusable ecological packaging for e-commerce ensures a high rate of return of the project, optimising the number of packaging use cycles (PraxPack Project, 2021).

The aim of the article is to identify critical processes in the context of the implementation of returnable packaging in e-commerce and potential risk factors of disruptions in the use of ecological reusable packaging in e-commerce logistics services, provided by Arvato Poland Sp. z o.o. based in Warsaw. The key aspect of the research is to eliminate the possible failure of the implementation of ecological returnable packaging in the e-commerce market. To achieve the purpose of the article, the following sub-tasks have been set:

- analysis of operational possibilities and innovative potential of Arvato Poland Sp. z o.o. based in Warsaw, in the context of e-commerce logistics services using reusable ecological packaging,
- preliminary identification of essential elements of the process,
- selecting activities critical for the process (in the sense of e-commerce logistics services) and the product (in terms of ecological reusable packaging),
- identifying the main groups of causes of potential irregularities in the electronic distribution channel.

The issue of unit returnable packaging is at the initial stage of research projects. The system approach used by the authors in the study of ecological reusable packaging in the sustainable development of circular e-commerce contributes to reducing the research gap in this thematic area.

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The research results presented in the article are part of a project implemented in 2021 under a research and development contract commissioned by Arvato Poland Sp. z o.o. based in Warsaw. The authors of the article present selected results of analyses carried out for one of the research tasks of the project, i.e. the diagnosis of risk factors in the use of reusable ecological packaging in e-commerce logistics services[2].

Literature review

The 'green' transformation of e-commerce is in line with the sustainable growth agenda of the European Commission (2019). The implementation of ecological returnable packaging in logistic e-commerce services is to accelerate the development of a resource-efficient and competitive circular economy (European Commission, 2022) and reduce supply chain costs. The activities in the field of planning production and consumption systems, taking into account the LCA assessment carried out in the last decade, confirm that the overall impact of European Union (EU) consumption related to the consumption of mineral resources, climate change, land use and dust pollution is close to exceeding the global ecological limits (Sala et al., 2020). Moreover, forecasts show that by 2050 the global consumption of materials such as biomass, fossil fuels, metals and minerals will double (OECD, 2018), while the amount of waste generated annually will increase by 70% over the period under study (Kaza et al., 2018). The "extract-produce-dispose" linear model, which is still dominant in the economy, will lead to a further significant waste of resources. At the same time, the extraction and processing of primary raw materials, taking into account the growing demand for packaging and the need to manage packaging waste, is responsible on a global scale for approx. 50% of greenhouse gas (GHG) emissions and 90% of biodiversity loss (IRP, 2019).

Extending the life cycle of unit shipping packages through their multiple use in electronic distribution channels is a derivative of economic, social and environmental changes, including climate change. The increase in social pressure related to the drive to reduce the environmental footprint and improve the quality of life in relation to e-commerce operations and processes that make up the entire e-supply chain is confirmed by the results of many studies (Oláh et al., 2019; Hischier, 2018; van Loon et al., 2015; Franklin Associates, 2018). The reduction of waste, i.e. zero waste, has recently been of particular interest (Cooper & Gutowski, 2017; ITU, 2020; ISPO, 2019).

[2] Due to the binding "data confidentiality" clause, the article presents the selected results of the analysis.

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This positive trend is significant in view of the rapidly growing amount of packaging waste. In Europe, in 2019, it reached a record level of 178.1 kg per capita, while in 2009, each inhabitant generated an average of 149.9 kg of packaging waste. In the period 2009-2019, the main sources of packaging waste were paper and cardboard, generating 32.3 million tonnes of waste in 2019 (Eurostat, 2022).

The dynamic development of the e-commerce market and the forecasts that in 25 years, approximately 75% of purchases in developed countries will be made online indicate a priority approach to the issues of packaging and packaging waste management. Research conducted by Zimmermann & Bliklen (2020) shows that single-use unit shipping packages are responsible for 10% – 30% of total GHG emissions related to e-commerce. Extending the life cycle of the packaging by using ecological reusable packaging allows for the reduction of GHG emissions by approx. 58%, in accordance with LCA (RePack, 2022). The growing interest of logistics entities in circular e-commerce models using ecological returnable packaging is therefore crucial to achieving climate neutrality by 2050. The global fashion industry has a significant impact on climate change. Cautious estimates for the fashion industry indicate that it is responsible for about 4% of the annual global GHG emissions (McKinsey, 2020; IPF, 2021). Continuing the current approach to managing the life cycle of fashion industry products, GHG emissions would increase by 60% by 2030.

Implementing circular economy solutions is therefore essential to reducing emissions in the fashion industry. This is confirmed by the preliminary results of the first pilot tests on the use of RePack packaging carried out as part of the praxPACK research project. The aim of the project is to popularise returnable packaging that can be recycled. Tchibo, Otto and Avocadostore are working together to develop solutions for practical reusable systems for e-commerce. The project started in August 2020. Initial pilot tests show that the closed-loop packaging service can reduce GHG emissions by up to 80% compared to disposable shipping packaging (PraxPACK Project, 2021).

E-commerce models using reusable eco-packaging also increase the level of possible decoupling of economic growth and resource decoupling and impact decoupling while increasing prosperity, favouring comparative advantage in international economic relations. It has been estimated that waste prevention and reuse can bring net savings for EU companies up to EUR 600 billion or 8% of annual turnover while reducing total GHG emissions by 2-4% annually (Kulczycka, 2020). Actions focused primarily on reducing the use of packaging, promoting reusable systems and reducing the complexity of packaging materials are promoted (European Commission, 2020). The essence is primarily a holistic approach and value chain, as well as extended producer responsibility and the role of the consumer (Kulczycka

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& Pędziwiatr, 2019). Data from the Green Generation report (2021) confirm that 37% of respondents believe that their approach to environmental protection influences more informed purchasing decisions. As many as 35% of respondents pay attention to whether the online purchases they order are packaged in an environmentally friendly manner. At the same time, 33% of respondents are ready for reusable packaging that should be returned to the indicated place.

Currently, an important issue for both companies and consumers is the values that a given brand presents, taking into account environmental and social aspects. Meanwhile, e-commerce causes more and more contradictory emotions among customers. Online shopping leads to an increase in the amount of packaging and packaging waste used in the order fulfilment process. A product that has been ordered often requires multiple packaging. This is due to, inter alia, returns, which are much more popular in this distribution channel than for traditional (offline) purchases. The scale of the problem is large, despite the fact that environmental awareness has become a common value in most countries. In the United States of America alone, returns cost retailers approximately $ 550 billion in 2020, an increase of 75% over 2016 (Accenture, 2021). At the same time, around 30% of cross-border returns ended up in landfills. These values vary greatly depending on the maturity of the e-commerce market and the type of goods sold. In European countries, the return rate in e-commerce averaged 48% in 2020, while in 2016, it accounted for 37% of e-purchases. The largest share in the volume of online returns concerned the fashion industry (over 50%), which highlights the need to implement ecological returnable packaging in line with the concept of a circular economy. In order for the idea of reusable packaging to be applied on a wider scale, it is necessary to involve all participants of the e-commerce market. The main challenges relate to the standardisation of processes and centralisation of deliveries for groups of products in unit returnable packaging and the development of a consistent packaging return system. These activities are crucial for the functioning of cost-effective e-commerce logistics with the use of ecological reusable packaging.

Materials and methods

Arvato Supply Chain Solutions Polska Sp. z o.o. based in Warsaw, is a leading provider of logistics services for e-commerce in Europe. It is one of the Company's 85 locations, operating in 20 countries around the world. They service 200 online stores around the world, carrying out over 100 million shipments annually, with the average rate of returns being 19% (Arvato Bertelsmann Supply Chain Solutions, 2022). The strategy of product and process

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excellence and innovation selected by the Company, related to the research and development work on the implementation of ecological returnable packaging, confirms the high level of maturity in the field of environmentally and socially responsible organisation in the context of packaging and packaging waste management, in accordance with the principles of the circular economy (Arvato Bertelsmann Supply Chain Solutions, 2021).

The subject of the analysis is the study of the possibility of using ecological reusable packaging in e-commerce logistics services, which is one of the available solutions with great potential to strengthen the sustainable development of the company. Primary and secondary data were used in the study. Data was obtained using various research methods and techniques, such as:

- Elementary analysis, which was used to divide the subject of the study into stages and describe each of them,
- desk research analysis, which was used to analyse documents and data provided by the Partner, research results, reports, strategic documents, legal acts, information from magazines, industry portals and other available sources,
- interviews conducted as part of study visits at the Partner's and meetings with experts from Arvato Poland Sp. z o.o. based in Warsaw, which made it possible to analyse operational activities as part of logistic e-commerce services,
- quantitative analysis methods that made it possible to verify the collected data (e.g. statistical analysis),
- causal analysis (e.g. "5 Why", Ishikawa Diagram), which was used to analyse the interrelationships in the e-commerce supply chain and identify critical processes for e-commerce logistics services using reusable eco-packaging.

Based on the review of the currently available literature data and materials provided by Arvato Poland Sp. z o.o. a set of issues was prepared in connection with the planned study visits and meetings with the Company's experts (Table 1).

Primary research was carried out in the form of study visits and in-depth individual interviews conducted in two locations of Arvato Poland Sp. z o.o. based in Warsaw made it possible to learn about the resources, essential elements and characteristics of the process and packaging products at the disposal of given locations. They also allowed for the selection and initial identification of key operations in the e-commerce logistics service process with the use of reusable ecological packaging. In-depth individual interviews were conducted with 38 employees of the Company directly involved in the implementation of the e-commerce service process. In the next stage, the results of these studies were verified during a working meeting with Arvato Supply Chain Solution experts in Poland, which allowed for the proper definition of

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the boundaries of the analysed system, as well as the decomposition of the tested system.

Table 1. Set of issues for the needs of individual interviews during study visits and meetings with experts of Arvato Poland Sp. z o.o.

Range	Description
Process flow map	• Characteristics of processes and stages of e-commerce order fulfilment • Identification of the strengths and weaknesses of the process in the evaluation of employees • Diagnosis of critical stages of operations in the product exit and entry (return) process, which may have a negative impact on the quality of the packaging, shortening its life, reducing process reliability, reducing operational safety, etc. • Getting to know the current methods in the field of prevention, reaction and detection of damage to the goods • Understanding the assumptions / possibilities of the packaging return process (acceptance, unpacking, quality control, procedures related to the safe use of the packaging, e.g. disinfection), transport, service, expected form of ownership (own, foreign, leased) • General assumptions regarding the applicable process improvement procedures in the company, risk monitoring tools, risk reactions
Customer profile assessment	• Number of orders per month / year by an individual customer • Number of returns per month / year by an individual customer • Average customer return time / time it was held at the customer's place • The level of customer loyalty to the company • Data on the period of cooperation with key contractors • The level of customer responsibility for the return of packaging
Packaging assumptions	• Package life cycle / adopted rate of package rotation • Features and properties of returnable packaging • The adopted level of packaging return • Time / stages of circulation of returnable packaging • Pricing strategy for goods shipped in new packaging • The impact of introducing a new packaging on the cost of delivery, the amount of insurance • The relationship between the cost of packaging, the amount of the deposit and the rate of packaging rotation • Flexibility in terms of replenishment of packaging / production stocks • The company's policy regarding the promotion of returnable packaging and other marketing activities • Environmental protection strategy

Source: authors' work.

As a consequence, potential critical processes have been identified. In addition, possible causes of irregularities were selected and prioritised, and answers to questions asked to a group of 17 experts of the Company were obtained. In arriving at understanding the problems, the general assumptions of the "5 Why" method were applied. Then, using the Ishikawa cause-and-effect diagram, these causes were interconnected in order to identify early potential risk factors (identified and hidden) in the process of logistics handling of e-commerce with the use of reusable eco-packaging.

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Results of the research

Critical processes in the context of the implementation of returnable packaging in e-commerce

Study visits carried out in two locations of the Partner, i.e. Swędów and Sosnowiec-Pieńki, confirmed that e-commerce logistic service is a critical process in the operations of Arvato Poland Sp. z o.o. they are based in Warsaw. Its implementation is monitored on an ongoing basis, in accordance with the applicable procedures of the company, which favours the pursuit of the proper quality of order handling. A simplified diagram of e-commerce logistics services using reusable ecological packaging, in accordance with the assumptions of the circular economy (circular economy), is shown in Figure 1.

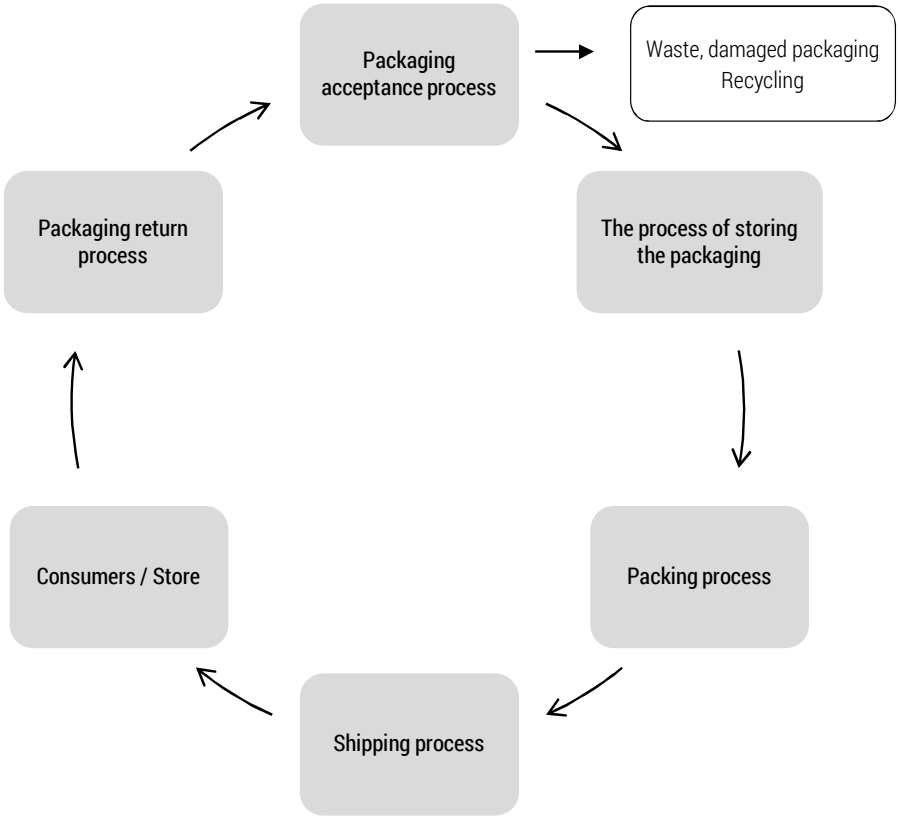

Figure 1. Scheme of e-commerce logistics services with the use of reusable packaging, in accordance with the assumptions of the circular economy

Source: authors' work based on study visits.

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The introduction of a new product in the form of reusable ecological packaging, while maintaining all packaging functions and the expected efficiency in relation to e-commerce logistics services, will be implemented in the Closed-Loop Supply Chain (CLSCM) model. As a result of the decomposition of the closed loop of e-commerce logistics services, it was first divided into stages (process control points), which may be places where disturbances arise. Then, for each of the indicated points, the elements and characteristics of the process and product were selected, significant for the identification of potential defects and inconsistencies in the implementation of e-commerce logistics services (Table 2).

Table 2. Initial identification of important control points for e-commerce logistics services

Checkpoints	Potential disruptions
Admission process	• Mechanical damage of packages • Surface defects, e.g. contaminated, deformed, permanent colour change of the packaging • High rate of return of damaged goods, e.g. discoloured, dirty, distorted • Difficulty determining liability for damage
The process of storing packages	• Low level of security during manipulations • Form / shape instability impeding storage • Large variability of packaging stock levels, e.g. large fluctuations in the time the packaging is retained by the customer, delays in the delivery of packaging from production due to high market demand
Packing process	• The dimensions of the packaging are not adapted to the product • Extending the packing time compared to packing orders in cardboard boxes • Failure to meet the required packaging quality standards for Premium orders • Inadequate protection against unwanted opening • Failure to adapt the design of the packaging to the correct placement of the courier label • Difficulty re-closure at the quality control stage
Shipping process	• The risk of losing the protective function of the packaging during transport and in the sorting plant • The risk of losing the functional function of the goods as a result of crushing, tearing, or exposure to shocks
C&C / B2C order collection process	• Failure to meet customer expectations in terms of safe use and manipulation • Unaesthetic appearance of the packaging • Unoptimized packaging dimensions • The presence of foil, fillers • Low level of acceptance for new packaging
The process of returning the packaging by the customer	• Low availability of the vending machine network • Problem with returning the goods due to defective / damaged packaging • Complaints due to problems with the return of the deposit • Low level of packaging return • Higher order handling costs • The need to monitor the return of packaging in real time (quantity, location)
The process for entering a return to the destination warehouse	• High rate of damaged packages and goods • Limited offer of carriers equipped with transport carriers reducing the risk of damage to packaging and goods • The risk of an increase in delivery costs

Source: authors' work based on study visits.

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Subsequently, the questions asked to the Company's experts allowed for a more detailed assessment of the essence of the disturbances and diagnosis of their causes. As a consequence, the critical processes were identified, including the acceptance process, the packaging process, the shipping process and the return process.

The analysis of operations in the acceptance process in the context of the use of reusable packaging in logistic e-commerce services indicated, inter alia, the possibility of potential disturbances related to the evaluation of the quality of the packaging. They concern both the product (packaging) and the quality assessment process, considering the possibility of its use in subsequent service cycles. Attention was also paid to the need to plan the place and organisation of the packaging storage process, as well as their disinfection. Another important factor from the perspective of optimising the reliability of the logistics service process is the possibility of quick and trouble-free identification of the packaging. Its absence was indicated as a potential source of disruptions in order processing.

The problems identified in the packaging process were assigned to three areas, i.e. packaging the order, placing the label and its verification, and the flow of the packaging to the shipping area in the warehouse. Using the systems approach, it was found that the probability of disturbances increases during the packing of orders, especially premium orders and the performance of accompanying quality control activities. They can lead to an extension of the implementation time of the aforementioned activities, which will translate into a decrease in the efficiency of the process. The probability of revealing the above disturbances is correlated with the incorrect dimensions of reusable packaging and the limitations resulting from the manipulation functions and ergonomic requirements.

Considering the increasingly frequent negative opinions of customers with regard to incorrectly dimensioned packaging in relation to the content of the order, this problem was indicated as significant in the context of the reusable packaging under study. Using the problem-based approach, other features and properties of the packaging were also analysed, which, due to the required protective, identification, transport, storage and use functions, may significantly determine the frequency of disruptions in the e-commerce logistics service process with the use of ecological returnable packaging. The importance of these features for customers was confirmed in the questionnaire survey, which was a project component.

The analysis of potential problems in the shipping process was narrowed down to the key area of activities in this process, i.e. packaging protection. Detecting and removing problems related to improper security of the packaging, which may result in damage to the ordered goods, is an important aspect of logistics services aimed at providing customers with products with

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preferred properties. An analysis of the operations carried out in the shipping process made it possible to conclude that the potential factors most often initiating damage to reusable packaging may be errors resulting from improper behaviour of carriers and drivers and inadequate collective packaging. Information "carefully" placed on parcels is of great importance to respondents participating in the study, which was confirmed by 45.5% of the respondents[3]. Therefore, it is important that it is respected by drivers and warehouse employees during handling and transport.

The application of the system approach allows us to see the scope and scale of potential disruptions in the shipping process, which are the effect of the interrelationships between individual subsystems. Disturbances resulting from problems resulting from relational relationships with clients emerge as the key ones. In the opinion of the respondents, reusable packaging should provide adequate protection against damage, which was indicated by 52.7% of respondents, confirming the great importance of this function. Another desirable feature of great importance is protection against external factors (48.9%). All activities in the shipping process that would prevent the implementation of these functions can be considered as potential risk factors in the context of logistics services using returnable packaging. Their causes, in addition to the aforementioned inappropriate behaviour of employees, may also be design and technological errors or hazardous material, which confirms the importance of decisions at the design stage.

In the diagnosis of risk factors for interference, it is also necessary to think in accordance with the LCA, which was used in the process of returning reusable packaging. Among the problems that may appear in the process of returning reusable packaging, there are, among others, such events as:

- the packaging does not meet the required material parameters relevant to the closed life cycle of the packaging (e.g. difficulties in achieving the required levels of recycling),
- the packaging is not an attractive solution for the Company/business partners in terms of the adopted technical and economic assumptions (high number of damages, reduced number of usage cycles),
- the packaging cannot be used in the next cycle of e-commerce logistics services (e.g. problems with the return of the deposit, complaints).

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3 The article presents selected survey results necessary for achieving the adopted goal of the article. Detailed results of the survey, which concerned the diagnosis of pro-ecological attitudes of respondents and their impact on the interest in returnable packaging in online shopping, are the subject of a separate article by J. Górniak, A. Bukowska-Piestrzyńska*, Unit packet on the e-commerce market as assessed of potential users – research results* (the article was directed to the review of the LogForm journal). The survey questionnaire contained 30 questions, including 5 open-ended. 1213 respondents took part in the CAWI survey, conducted in the period 04.05.2021 – 26.06.2021.

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There were general and more specific issues in the process of returning reusable packaging in identifying issues. Detection of problems disrupting the performance of the required functions with regard to reusable ecological packaging and practical improvement actions in the area of improving the quality of these packaging are in line with meeting customer expectations. For over 73% of respondents, the ecological features of the packaging and the possibility of its recycling are of great and very great importance. The survey results confirmed the high level of environmental awareness of the respondents, who indicated their willingness to use returnable packaging. At the same time, such features as durability, protection against external factors, protection against unauthorised opening, destruction and the possibility of re-use were recognised by over 80% of the respondents of the CAWI survey as important and very important attributes of the packaging. The absence or insufficient fulfilment of these expectations can be considered a potential source of problems and distortions.

Potential risk factors of disruptions in logistic e-commerce services with the use of ecological returnable packaging

Based on the analysis of the most common problems diagnosed in critical processes, factors could potentially lead to a decrease in the efficiency of operations in the warehouse of Arvato Poland Sp. z o.o. with headquarters in Warsaw and the loss and damage of products in the transport process in the field of returns handling. Their identification is crucial from the perspective of the Company's strategy in the field of packaging and packaging waste management, taking into account the principles of sustainable development.

The development of Ishikawa diagrams (Table 3 and Table 4) made it possible to determine the leading (general) causes and then to detail them by identifying secondary factors (detailed causes) and selecting key factors that had the strongest impact on the decline in the efficiency of processes in Arvato's warehouse and the level of losses and damage to goods in the transport process in the field of returns handling. These factors, in the next stage of the analysis, were potential risk factors.

The selected main causes and secondary factors indicate the directions of taking actions to improve the logistic service of e-commerce with the use of returnable packaging and facilitate problem-solving. The presented diagrams in the form of tables can be analysed in two directions (Kowalska & Paździor, 2015):

- from the main axis (horizontal) towards the "fishbone" – obtaining answers to the question – why is a given problem / defect / non-compliance revealed in e-commerce logistics services?

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- from individual secondary factors and causes towards the main axis ("fish back") – to get the answer to the question – what effect does this have?

The study assumes that the most important groups of causes are potentially related to Man, Machine, Method, Material, Measurement and Environment.

Table 3. Selected problems in the critical process – packaging return

Problem statement	Loss and damage of products during the transport process in the scope of handling returns	
Range	Main problems	Detailed problems
Methods	• Wrong way of preparing the return shipment by the customer • Incorrect methods and forms of packing returns on transport carriers • Inadequate securing of cargo in cages • Inadequate securing of cargo on pallets • Inadequate securing of cargo in Big Boxes	• Difficulty closing the package • Insufficient product protection • Lack of care for the proper quality of activities in the return process • Inadequate load distribution • Disregard for manipulative and informational signs • Limited surveillance system • No lashing nets • Inadequate closure of cages • Incorrect way of unloading the car • No clamping beams • Incorrect arrangement of the pallets • Wrong way of securing products on a pallet • Incorrect stacking on pallets • Inadequate blocking and blocking
Machines (equipment)	• Inadequate technical equipment • Vehicle breakdown	• Incorrect handling equipment • No isobines in transport • Road accident • Incorrect driving speed • Incorrect vehicle tonnage
Measurement	• The inadequate organisation of loading and unloading • Difficult communication with external companies performing deliveries (transport, courier) • Inappropriate management of the packaging life cycle • There are no standardised procedures for measuring operational efficiency	• Inadequate management of loading / unloading processes • Failure to follow plant procedures related to the handling of transport operations • Inadequate training of employees • Bad choice of carrier • No clearly defined cooperation procedures • Low level of trust and transparency in the flow of information • No initiatives to create new models of cooperation • The complexity of the implemented system solutions • Time-consuming real-time testing of new procedures • Lack of willingness to develop appropriate measurement tools • Insufficient awareness of the potential benefits
Materials	• Inadequate transport packaging • Incorrect collective packaging • Defect in unit packages	• No new investments • Safety decrease in the process of returning packaging and goods • Extended unloading time • Difficult manipulative processes • High index of susceptibility to mechanical damage of packaging and goods

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Environment	• Improper storage • Exposure to high temperatures	• Loss of protective functions • Heavy rainfall • High humidity • Reducing the attractiveness of the packaging • Discoloration • Permanent damage to the packaging surface
People (manpower)	• Carriers inaccuracy in the return process in domestic and international service • Improper behavior of drivers and couriers • Driver skills • Customer misconduct	• Failure to follow the procedures • Ignorance of procedures • Routine at work • Imprudence • No driver involvement • Inattention • Haste • Inadequate qualifications • Experience too short • No motivation • No self-control • Failure to comply with the provisions of the regulations regarding the preparation of products for return • Lack of damage awareness in terms of return logistics • Lack of care for the packaging

Source: authors' work.

Based on the analysis of the information obtained, the possibility of 44 potential causes of non-compliance (with various levels of detail) was identified in the context of the decline in the efficiency of e-commerce orders in the warehouse of Arvato Poland Sp. z o.o. it was based in Warsaw with the use of ecological returnable packaging. The most important of them are presented in Table 3. In order to respect the principles of sustainable development, it is important to prepare warehouses for the effective implementation of ecological returnable packaging in e-commerce logistics and packaging waste management. This mainly applies to an appropriate number of pilot tests involving returnable packaging, developing procedures for assessing the quality of these packaging, ensuring appropriate conditions and places of their storage, as well as instructions for use and proper management of damaged packaging and packaging waste. It would also be necessary to develop an effective deposit system and subject it to pilot tests in order to determine the required level of packaging returns (the number and time of returning the packaging from the customer to the warehouse). The specified activities constitute the basis for reducing disruptions in the process of returning packaging to the warehouse and its reuse in the handling of e-commerce orders. Eliminating the occurrence of risk factors helps to reduce the amount of additional work in the warehouse, increase the number of packaging use cycles and reduce the amount of packaging waste. As a result, the process of logistic handling of e-commerce orders will have a smaller negative impact on the environment.

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The development of the Ishikawa diagram for product losses and damage in the transport process in the field of returns handling allowed the identification of 75 general and secondary causes. The key ones, due to the degree of importance and detail, are presented in Table 4. The conducted analysis indicates a high probability of the occurrence of disturbances. It increases in particular when there is a high rotation of packaging in logistic e-commerce services. The elements that create potential disruptions in the transport process in the field of handling returns using reusable ecological packaging mainly relate to the human factor, methods and organisation of the transport process. The different types of potential disturbance are similar or the same in terms of their effects. This allows for the identification and taking of appropriate remedial actions in order to eliminate or reduce the consequences of disruptions in the process of handling returns. The most important of them include training for the Company's employees and drivers handling orders, on proper conduct during inter-operational transport, appropriate packaging and selection of collective packaging. Talks with carriers and courier companies should be undertaken and, based on the requirements for appropriate collective packaging, system changes should be considered, which may have an impact on optimising the time and safety of packaging and transport of reusable unit packaging.

Table 4. Loss and damage of products in the process of transport in terms of handling returns

Problem statement	Decline in the efficiency of processes in the Partner's warehouse – Arvato Poland Sp. z o.o.	
Range	Main problems	Detailed problems
Methods	• There are no uniform instructions on how to deal with complaints about damaged returnable packaging. • There are no guidelines for the proper fulfilment of heterogeneous Premium orders using reusable packaging. • There are no clearly defined procedures for implementing reusable packaging for e-commerce logistics services	• Extending the time for considering complaints and reducing customer satisfaction • Increase in the number of customer requests for extended deposit return times • Errors in assessing the quality of reusable packaging introduced to the warehouse
Machines (equipment)	• Delays in implementing system solutions	• Low level of automation in selected locations
Measurement	• Insufficient number of pilot tests on the use of reusable packaging to support e-commerce • Insufficient coordination of activities with external companies in the field of e-commerce • Limited cooperation offer with carriers meeting certain conditions of transport	• Inadequately trained Staff • High employee turnover • An underdeveloped system of process monitoring tools • Limited flow of information • Late information about errors • Excess work in relation to available resources

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Materials	• Defective packaging • Limited durability of the package • No systemic solutions to close supply chains with reusable packaging as part of new business models	• Unsuitable suppliers • Limited product offer • Shortening the service life of the packaging • Technical errors • Manufacturing defects
Environment	• Inadequate storage conditions for packaging • Improper disinfection and cleaning of the packaging	• Reduction in the functionality of the packaging
People (manpower)	• Too long working time in the admission process • Extending the execution time of an operation in the Packprocess • Decrease in the effectiveness of activities at the stage of quality control of the contract • Extending the time of securing and packing orders in the shipping process	• Difficulties in properly assessing the quality of reusable packaging returned to the warehouse • Inadequate qualifications • No self-control • Lack of commitment during training and testing • Insufficient experience in using new packaging in the packaging process • Lack of awareness of the appropriate quality of the contract • Incorrect decisions regarding the qualification of the packaging for the next use cycle • Failure to follow company procedures aimed at ensuring the quality of contract execution • Insufficient skills for premium orders • Lack of accuracy • Insufficient knowledge of procedures • Limited cooperation with carriers and couriers collecting orders from the warehouse

Source: authors' work.

The causal analyses carried out with the use of the Ishikawa diagram indicate a high complexity of problems in the context of the use of returnable packaging in logistic e-commerce services. They make it possible to visualise the causes of potential disturbances, defects and non-conformities. The problems were identified with varying degrees of detail. Each aspect was analysed, taking into account the entire process of logistic e-commerce service, at the same time taking into account the features and functions of ecological returnable packaging.

Conclusions

Based on the research results presented in the article, it can be concluded that the improvement of the quality of e-commerce logistics services with the use of ecological returnable packaging reflects the efforts of Arvato Poland, based in Warsaw, to implement environmentally friendly and economically practical solutions, at the same time meeting the expectations of customers. However, it is connected with the necessity to constantly monitor the imple-

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mentation of the service process, which is exposed to many potential disruptions, despite its proper organisation. Applying the systemic approach allowed us to identify critical functions and risk factors of disruptions in the implementation of reusable ecological packaging to service orders on the e-commerce market. Selecting the main causes and detailing them allows you to take actions to improve the efficiency of the process and improve the product.

The analysis of data collected during study visits and interviews with the Company's experts allowed for the identification of 4 critical processes, constituting sources of potential disruptions in the use of returnable packaging in the handling of e-commerce orders, in accordance with the principles of sustainable development. The identified critical processes are receipt, packing, shipping and return of the package.

In the process of accepting ecological returnable packaging to the warehouse, it may be problematic to control the quality of the packaging, its disinfection and the place of storage. Problems diagnosed in the packaging process indicate difficulties with time-efficient packaging of orders, especially Premium, as well as with the placement and verification of the label. In the shipping process, disruptions related to inadequate protection of reusable eco-friendly packaging were considered to be the most problematic for e-commerce logistics services. They can damage not only the packaging but also the goods it contains, causing economic, environmental and social losses in the context of non-fulfilment of the contract. Potential disturbances may also result from structural defects of the packaging or material susceptible to damage, which confirms the essence of the product approach in accordance with LCA. The disclosure of these defects and undesirable features of the package can be a significant source of potential problems and disturbances in the package return process. Their manifestation may be a large number of complaints about damaged goods or a reduction in packaging use cycles, which may result in a low assessment of the quality of e-commerce logistics services. In the return process, potential disruptions related to low packaging turnover cannot be ruled out either.

The conducted cause-and-effect analysis with the use of the Ishikawa diagram allowed for the identification of potential causes disrupting the logistics service of e-commerce with the use of ecological returnable packaging. The clearly shown main and secondary causes related to man, machine, method, method, measurement and the environment are important to reduce the risk factors of disruptions in the implementation of ecological returnable packaging in e-commerce logistics services, in accordance with the principles of sustainable development. When managing individual risk factors of disorders, greater emphasis should be placed on, among others, pilot tests with the use of returnable packaging, employee training, development of

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procedures for securing the packaging both during transport, as well as during storage and storage, as well as increasing expenditure on quality control. In the initial phase, these activities may increase the costs of e-commerce logistics, but in the later perspective, they should have a significant impact on environmental protection in the context of packaging and packaging waste management. At the same time, without reducing the efficiency of logistics services, I can provide greater functionality of ecological returnable packaging.

The contribution of the authors

Urszula Motowidlak 50% : establishing the concept, establishing research methods, creating text, analytical description of the phenomenon, implementation of the research idea, critical assessment, data collection, data analysis and interpretation, development of research results, review of the literature

Daniel Tokarski 50%: establishing the concept, establishing research methods, creating text, implementation of the research idea, data collection, data analysis and interpretation, development of research results, review of the literature, author's correspondence.

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