

PREMISES AND POTENTIALS FOR REDUCING GENERATION OF PACKAGING WASTE BY THE E-COMMERCE INDUSTRY

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Purpose of the study: This study attempts to answer the question whether it is possible to reduce the quantity of packaging waste generated by online stores through modification of the ways they operate. Due to the dynamic development of e-commerce, the problem of packaging waste is becoming increasingly visible – its overall quantity has increased significantly in recent years. Daily observations of online shoppers and review of websites of packaging manufacturers, for e-commerce demonstrate that problems such as empty space in boxes or the use of various types of fillers or too much plastic are important for both buyers and sellers. Given these phenomena and expected growth trends – both in terms of the packaging waste generated by e-commerce and the need to pursue the principles of sustainable development – actions should be taken to implement the first goal of the waste hierarchy: reduction of the quantities of waste.

Methodology/approach: In order to answer this question, a survey was conducted among consumer electronics store employees responsible for shipping products. The survey questionnaire contained questions and responses arranged on a Likert scale.

Limitations: The study touched upon the issue of reducing the quantity of waste generated by e-commerce and focused mainly on changing the approach in stores at the operational level. Meanwhile, it would be possible to introduce changes already at the stage of packaging production. It is known that new materials and products are being developed which could be used for shipments, as they are greener. It is certainly possible to make changes at the packaging design stage.

Implications: The conclusions of the following study are primarily applicable at the operational management level. On their basis, guidelines and tips for packaging in e-commerce shops can be formulated.

Value: The study shows a great potential for online store staff in terms of reducing empty spaces and fillers, and also confirms the existence of a trend in perceiving “green” stores as more competitive.

Keywords: e-commerce, packaging, packaging industry.

Category of the paper: Research paper.

1. Introduction

Packaging waste, defined as post-consumer packaging, withdrawn from use and constituting waste within the meaning of waste regulations, is an important issue from the point of view of the protection of the environment and natural resources. Between 2009 and 2019, the quantity of this type of waste increased by 20.5% in the European Union (Ochrona środowiska, 2022). And although it is possible, at least in Poland, to achieve the desired levels of recovering and recycling, waste management remains a very important subject and a problem because it is not possible to implement the principles of waste hierarchy in this area, according to which, in the first instance, the production of waste should be avoided in general.

E-commerce is one of the sources of particularly large quantities of packaging waste. According to the Polish Central Statistical Office, 64.6% of people aged 16-74 made purchases online in Poland in 2022 (compared to 61.2% in 2021) (Społeczeństwo informacyjne w Polsce, 2022) and this is the result of a long-standing trend. Therefore, the e-commerce industry, as online trade is also called, can be considered one of the main culprits of the increase in the quantity of packaging waste. The increase in the amount of waste generated in e-commerce is, of course, due to the growth of the industry, but this increase is disproportionate. It seems that packaging is undergoing the next stage of evolution in online trade. While they previously played the role of a marketing and communication instrument, in e-commerce they return to their most original role, i.e. product protection, this time in transport over longer distances. Thus, the quantities of smaller and larger cardboard boxes, various types of plastic film, paper and plastic materials, which are intended to protect products purchased online on their way to the customer, are growing. The question inevitably arises about the possibility of reducing this waste stream.

2. Literature review

As consumers' purchasing preferences shift from traditional retail channels towards e-commerce, the harmful impact of e-commerce is readily apparent. For example, it is estimated that online shopping generates 4.8 times more packaging waste than offline shopping for the same amount of spending (Tokar et al., 2021). Some see the need to change policy in this area to prevent further environmental damage caused by packaging waste from online shopping (Kim et al., 2022), and it is also recognized that this is a task for managers and planners (Adibfar et al., 2022). Online shopping has brought convenience to customers, retailers are constantly making efforts to improve the online shopping experience, and packaging must cope with the rapid growth of the industry.

One of the most important threads in packaging research is that of packaging design, which should take into account issues related to the packaging waste generated (Yin et al., 2023; Spruit, 2021, Kazancoglu et al., 2023). Escursell et al. (2021) note that packaging materials and technologies evolved rapidly until the 1990s, but thereafter it became increasingly difficult to further reduce their costs and environmental impact. Furthermore, some packaging products are still manufactured from non-renewable materials and there is a need for further research to make new packaging from renewable sources, such as cellulose-containing materials that are widely available in nature, or from recycled cellulosic materials, such as cardboard. Streamlining distribution processes with new and more effective tools could further help mitigate the environmental impact of packaging. Similarly, new manufacturing processes such as additive manufacturing and 3D printing can help optimize packaging volume and shape, thereby facilitating more sustainable manufacture, for example by reducing CO₂ emissions. The technology currently available could be useful in rethinking the entire e-commerce packaging paradigm, which has changed very little over the last few decades (Escursell et al., 2021).

The growth of e-commerce and, therefore, the increase in the quantity of waste it generates was also influenced by the CoViD-19 pandemic (Kim, 2020; Nath et al., 2023; Yang et al., 2023), as well as the expansion of express delivery services (Pinos et al., 2022). Another reason is the overpackaging found, for example, in the electronics industry and resulting from the tendency of vendors to protect the product from damage in transport (Lu et al., 2020) or in food industry (Lin, 2022) but also in e-commerce in general (Xie et al., 2021). As an upward trend is expected, questions arise about recycling costs and whether producers of packaging waste are charged appropriately (Cruz et al., 2014) and the issue of packaging in the context of the circular economy has long been emerging (Novakovic et al., 2023; Nielsen, Hakala, 2023; Palazzo et al., 2023).

In the research on e-commerce packaging there is also a thread related to competitiveness of enterprises. Some studies confirm that there is a relationship between pro-environmental, or “green”, solutions used by companies and customer satisfaction and loyalty. This means that the more attention online retailers pay to eco-friendly delivery (parcel lockers, collection points, click & collect), packaging (responsible materials and packaging sizes) and post-consumer returns (returnable packaging, return of end-of-life products), the more are consumers satisfied, loyal and willing to make repeat purchases (Kawa, Pierański, 2021). Studies that have shown this were carried out, for example, in the UK. According to them, one third (33%) of consumers currently decide to buy from brands that, in their opinion, do something good for society or the environment (Unilever, 2017) and rational packaging management in e-commerce adds to its competitiveness (Kim et al., 2021).

The last thread in research on e-commerce packaging concerns the next levels of the waste management hierarchy, after avoiding generation, i.e. waste recovery and recycling. Research conducted on this suggests that there are great opportunities to reduce the consumption of packaging materials and then mitigate their impact on the environment (Su et al., 2020) both in

the technological and management spheres. With regard to packaging used for online shopping, there is a need to create conditions for full recycling and/or reusability. Thus, e-commerce companies, and therefore also customers who would be responsible for returning packaging, face a challenge – the use of reusable packaging (Bukowska-Piestrzyńska, Górnjak, 2023).

3. Research hypotheses and methodology

The analysis of existing threads in the literature regarding e-commerce packaging made it possible to ask several practical questions regarding the business of mail-order stores in the context of reducing the packaging waste they generate. According to the main hypothesis of this study, it is possible to reduce the quantity of packaging waste generated by online stores right now – by modifying their methods of working. Based on this main hypothesis, four secondary hypotheses were formulated, which resulted from observations of everyday practices of this type of stores. These hypotheses are as follows:

- (h1) There is potential for more eco-friendly packaging for shipping goods in online stores.
- (h2) The “greenness” of packaging benefits the company’s competitiveness.
- (h3) Voids in packaging can be reduced and fillers and plastic elements can be eliminated.
- (h4) Managers are ready to take action to make packaging more environment-friendly.

The research tool was an anonymous survey conducted among employees of online stores. The questionnaire consisted of 13 questions in which respondents were asked directly about the phenomena under study and asked to rate them using a Likert scale. The questions in the survey were designed to verify the hypotheses set at the beginning of the study. Some of the respondents spontaneously shared their opinions on the topics discussed in the survey, which was taken into account in the interpretation of the results.

4. Research results

Responses were received from 47 persons – managers from the e-commerce industry and employees of online stores responsible for shipping goods to customers, preceded by packaging. The research sample consisted of 35 men and 12 women. The mean age of the respondents was 38 years.

The questionnaire contained 13 questions, in the grammatical form of affirmative statements, with responses using a 5-point Likert scale intended to verify the hypotheses formulated based on the identified research gap. For each statement, respondents could choose from among 5 responses consisting of a verbal and numerical description, arranged in order from 100% denial to 100% agreement:

- 1 – I strongly disagree.
 2 – I tend to disagree.
 3 – Neither yes nor no.
 4 – I tend to agree.
 5 – I strongly agree.

On this basis, a weighted average was calculated for each statement, providing information about the side and strength of the attitude towards each statement. The answers are presented in Table 1.

Table 1.
Questions (affirmative statements), responses and weighted averages

N°	Question/Response	I strongly agree	I tend to agree	Neither yes nor no	I tend to agree	I strongly disagree	Weighted average
		% of responses					
Q1	The issue of packaging waste from mail order sales worries me.	59.57	31.91	8.5	0	0	4.51
Q2	Packaging and environmental issues related to it are becoming more and more important to consumers.	63.82	29.78	0	4.25	2.12	4.48
Q3	Online stores that respect the principles of ecology and sustainable development have a competitive advantage over other online stores.	95.74	2.12	2.12	0	0	4.93
Q4	Shipping packaging in an online store could be “greener”.	93.61	4.25	2.12	0	0	4.91
Q5	When shipping from an online store, the quantity of plastic ancillary materials (adhesive tapes, fastening tapes) could be reduced.	6.38	10.63	42.55	40.42	0	2.82
Q6	When shipping from an online store, it would be possible to reduce empty space in packages.	91.48	4.25	4.25	0	0	4.87
Q7	Reducing the empty space in a parcel shipped by an online store would reduce logistics costs.	91.48	6.38	2.12	0	0	4.89
Q8	It is possible to reduce the quantity of “fillers” in shipments from online stores (stretch foil, bubble wrap).	74	17.02	8.5	0	0	4.65
Q9	It is possible to reduce the use of other “fillers” in packaging used for shipping by online stores.	14.89	19.14	19.14	31.91	14.89	2.87
Q10	Most parcels are packed in such a way that they are difficult to open and are frustrating for the consumer.	74.46	19.14	6.38	0	0	4.61
Q11	Packaging that is difficult to open or is unsustainable may effectively discourage a consumer from purchasing a product of the same brand again.	6.38	10.63	19.14	36.17	27.65	2.31
Q12	I am ready to diversify my approach in my work and put more effort into making the packaging more “eco” (so that it is not a source of much waste).	42.55	31.91	23.4	2.12	0	4.14
Q13	Most packaging could be designed slightly differently to generate less waste.	80.85	10.63	4.25	4.25	0	4.68

Source: The author’s own study.

The first three questions/statements concerned the general perception of the issue of waste generation by the e-commerce industry. The first statement (Q1), according to which the issue of packaging waste from mail order sales is worrying, has an average weight of 4.51. This means that the respondents considered the phenomenon, as well as the threats resulting from it to be noticeable: 91.48% of respondents believed so. The respondents also believed that “packaging and environmental issues related to it are increasingly important to consumers” – this statement (Q2) has an average weight of 4.48 and 93.6% of respondents agreed with it. In the next statement (Q3), this observation was confirmed and supplemented with the aspect of competitiveness. 97.86% of the respondents agreed with the statement that online stores that respect the principles of ecology and sustainable development have a competitive advantage over other online stores – the result is the highest weighted average (4.93) and this is the strongest statement in the entire survey.

The next six questions concerned the method of packing as such itself and the possibility of reducing the quantity of waste in e-commerce stores. The results of this part of the study are inconclusive. The respondents agreed that shipping packaging in an online store could be more “eco” (Q4 – 4.91, 97.86%), that empty space in parcels could be reduced (Q6 – 4.87, 99.98 %) and that it would reduce logistics costs (Q7 – 4.89; 99.98%). Slightly narrower acceptance, although still quite wide, was noted for the statement that the number of “fillers” in shipments from online stores (stretch foil, bubble wrap) could be reduced (Q8 – 4.65; 91.02%). The weighted average agreement to statement that the quantity of plastic ancillary materials (adhesive tapes, fastening tapes) could be reduced when shipping in an online store (Q5 – 2.82; 42.55%). To an even lesser extent, the respondents agreed with the statement the use of other “fillers” in packaging used for shipping by online stores can be limited (Q9 – 2.87; 34.03%).

The last four questions of the survey concerned the consumers’ reaction to non-green packaging and the possibility of more ecological packing of parcels in online stores and designing packaging in such a way that it generates less waste. First of all, the majority of the respondents (63%) did not agree with the statement that non-ecological packaging can effectively discourage repeated purchases (Q11 – 2.31), but at the same time the respondents confirmed that most parcels are packed in such a way that they are difficult to open and that opening them is frustrating for the consumer (Q10 – 4.61; 93.6%). In response to question Q12, a majority of respondents (74.46%) declared their readiness to diversify their approach in their work to make the packaging more ecological (4.14). In the last statement, the respondents confirmed that most packaging could be designed slightly differently to generate less waste (Q13 – 4.68; 91.48%).

5. Discussion

Hypotheses (h1), according to which there is a potential for more ecological packaging for shipping goods in online stores, and (h2), according to which the “ecological” nature of packaging benefits competitiveness should be considered positively verified. The study has confirmed that the issues of packaging waste from mail order sales are worrying for representatives of the e-commerce industry, and environmental issues related to them are becoming increasingly important for consumers. The statement that online stores that respect ecological principles are perceived as more competitive has also been confirmed. This state of affairs confirms the research hypothesis formulated based on the existing research. Employees in the e-commerce sector notice the problem of waste from their industry. In the general view of both employees and customers of online stores, ecological issues are gaining on importance, and competitiveness of e-commerce stores is correlated with whether they respect the principles of ecology and sustainable development. It should be noted that the term “ecology”, or “greenness”, was not defined in detail in the study – on purpose. While the adjective “ecological” is commonly used in very different contexts and areas of life, it seems that most people use it to mean “related to environmental protection” – and the term was used in this sense in the study. It is also commonly believed that one of the aspects of “environmental protection” is the reduction of the quantity of waste generated, including packaging waste, and that it is in this sense that the word “ecological” is used. The study has shown that the ecological approach of e-commerce stores in terms of the packaging used by them may be a factor improving their competitiveness. There are many strategies to ensure that stores – not only e-commerce ones – remain competitive on the market, and the subject of their effectiveness is extremely comprehensive. Undoubtedly, however, “being eco” is gaining on importance as a factor of competitiveness due to growing awareness of environmental issues in societies. Therefore, it is a reason to take measures aimed at cultivating the image of e-commerce enterprises as “greener”. The respondents also said that shipping packaging in an online store could be more “eco”. This is an important statement because it comes from employees themselves who, as those closest to the packaging process, notice the lack of optimization in the selection of packaging. In additional comments on this topic, the respondents emphasized that there was a great potential to improve packaging. The employees surveyed admitted that packing is primarily aimed at securing the goods for transport. Some emphasized that their priority was to deliver shipments as quickly as possible and that that was the main goal of shipping companies, and the most important expectation of customers. As the respondents admitted, given such goals, the subject of adjusting the packaging in terms of size to the dimensions of the product becomes less important and it is much easier to use larger packaging in which voids are closed with additional materials (fillers).

Thus, hypothesis (h3) has been partially confirmed, according to which “air gaps” in packaging can be reduced and fillers and plastic elements can be eliminated. This hypothesis was verified using 7 questions, and the answers are not entirely clear. The low average weight comes to the fore when it comes to the statement that packaging that is difficult to open or is non-green may effectively discourage a consumer from purchasing a product of the same brand again. This is a very important suggestion for the market. While the respondents agreed with the very general statement that environmental friendliness promotes competitiveness, they tended to disagree with the more specific statement that a brand would lose popularity due to the fact that its products are packaged in a non-green manner. This is, of course, relatively simple to explain by the fact that brand loyalty is something different than the perception of an online store and shipping.

The respondents moderately agreed with the statement that the number of plastic packaging elements could be reduced in online store shipping (Q5). In additional comments, they justified this by the fact that currently these materials and their use are often already reduced to the necessary minimum. Plastics in mail order stores are used primarily in the form of ancillary packaging materials, such as adhesive or fastening tapes and bubble wrap to protect the product in transport against damage. The respondents declared that plastics were used less and less often as fillers of voids, for which purpose they increasingly used paper, among others. Next, they agreed that the quantity of “fillers” in online shipping, such as stretch film and bubble wrap, could be reduced (Q8) and, at the same time, they were less likely to agree with the statement that other “fillers” used in shipping packaging could be reduced. It turns out that it is necessary to use fillers, even paper ones, and the trend of moving away from plastic is already noticeable.

The statement about the possibility of reducing overall empty space in parcels sent as part of online sales (Q6) and the related possibility of reducing logistics costs (Q7) also met with strong acceptance. This issue also provoked many additional spontaneous comments from the respondents, which they shared in the survey. They confirmed that the phenomenon of empty space in boxes delivered after online shopping is extremely common and even has a name: the “empty space economy” consisting in “carrying air and fillers” is perceived very critically by the respondents. They noticed a number of negative consequences associated with this phenomenon: ranging from increased transport costs if packages take up more space than the size of the product, through generating unnecessary waste, to customer disappointment and frustration resulting in adverse publicity. One of the respondents drew attention to marketing aspects: There are popular videos on YouTube channels in which customers review products purchased online, also commenting on the packaging and often expressing unfavorable opinions about brands that use excessive quantities of fillers. This comment was reflected in the survey in response to the question about consumers’ frustration with opening a package that is difficult to unpack (Q10).

The last two questions of the questionnaire were used to verify hypothesis (h4), according to which managers are ready to take action to make packaging greener and to examine the possibility of changing the approach to packaging in online stores in such a way that packaging from this type of sales does not generate so much waste. Representatives of the e-commerce industry are willing to diversify their approach at work and make more efforts to make packaging more environment-friendly. As many as 80% of the respondents fully agreed with the statement that most packaging could be designed in a slightly different way to generate less waste.

6. Conclusions

The research can offer both general conclusions, regarding the situation of waste management in the online sales industry, and conclusions regarding management issues. First of all, it should be noted that the problem of too much waste generated by the industry is so great that it has not escaped the attention of its employees and customers, and this problem could be solved. This would bring benefits not only for the environment, but also for e-commerce which must treat ecology as an element of their competitive strategy in times of growing environmental awareness of society. Secondly, online store employees are willing to modify their procedures to make packaging greener. Empty space in parcels should certainly be reduced – there is potential for this. This can be achieved by purchasing a wider range of box sizes which should be matched to products. Thirdly, we must not forget that the process of packing goods in online stores is primarily intended to protect products in transport. However, it is still not a factor determining the brand's popularity.

The study described in this paper had its limitations. Thus, it touched upon the issue of reducing the quantity of waste generated by e-commerce and focused mainly on changing the approach in stores at the operational level. Meanwhile, it would be possible to introduce changes already at the stage of packaging production. It is known that new materials and products are being developed which could be used for shipments, as they are greener. It is certainly possible to make changes at the packaging design stage. The study only highlights issues related to existing and marketed packaging: their recycling and upcycling, as well as their reintroduction into economic circulation. These matters should certainly be investigated in future research and economic practice.

References

1. Adibfar, A., Gulhare, S., Srinivasan, S., Costin, A. (2022). Analysis and modeling of changes in online shopping behavior due to Covid-19 pandemic: A Florida case study. *Transport Policy*, Vol. 126, pp. 162-176.
2. Bukowska-Piestrzyńska, A., Górnjak, J. (2023). Unit packets on the e-commerce market as assessed by potential users – research results. *Gospodarka Materialowa i Logistyka [Materials Management and Logistics]*, No. 2, pp. 30-37.
3. Escursell, S., Llorach-Massana, P., Roncero, M.B. (2021). Sustainability in e-commerce packaging: A review. *Journal of Cleaner Production*, Vol. 280, Part 1.
4. Ferreira da Cruz, N., Ferreira, S., Cabral, M., Simões, P., Cunha Marques, R. (2014). Packaging waste recycling in Europe: Is the industry paying for it? *Waste Management*, Vol. 34, Iss. 2, pp. 298-308.
5. Imran, M., Khan, I., Nassani, A.A., Binsaeed, R.H., Rashid Khan, H. ur, Qazi Abro, M.M., Zaman, K., Haffar, M. (2023). A green perspective: Investigating the optical effects of e-commerce, renewable energy demand, and services trade on carbon emissions. *Optik*, Vol. 283.
6. Kawa, A., Pierański, B. (2021). Green logistics in e-commerce. *LogForum*, 17(2), pp. 183-192.
7. Kazancoglu, Y., Ada, E., Ozbiltekin-Pala, M., Uzel, R.A. (2023) In the nexus of sustainability, circular economy and food industry: Circular food package design. *Journal of Cleaner Production*, Vol. 415, 137778.
8. Kim, R.Y. (2020). The Impact of COVID-19 on Consumers: Preparing for Digital Sales. *IEEE Engineering Management Review*, Vol. 48, No. 3, pp. 212-218.
9. Kim, Y., Kang, J., Chun, H. (2022). Is online shopping packaging waste a threat to the environment? *Economics Letters*, Vol. 214, 110398.
10. Kim, J., Kim, M., Im, S., Choi, D. (2021). Competitiveness of E Commerce Firms through ESG Logistics. *Sustainability*, Vol. 1, 11548.
11. Lin, J. (2022). How to reduce overpackaging of food in China: Analysis based on evolutionary game. *Sustainable Production and Consumption*, Vol. 31, p. 529.
12. Lu, S., Yang, L., Liu, W., Jia, L. (2020). User preference for electronic commerce overpackaging solutions: Implications for cleaner production. *Journal of Cleaner Production*, Vol. 258, 120936.
13. Nath, O., Kumar, S., Sharma, V., Meena, M.L., Jain, R. (2023). Design of strategic framework for green sustainable practices in e-commerce companies. *Materials Today: Proceedings*.
14. Nielsen, I.B., Hakala, H. (2023). External enablers for the circular economy: A case study of the food packaging industry. *Journal of Cleaner Production*, Vol. 417, 137915.

15. Novakovic, K., Thumbarathy, D., Peeters, M., Geoghegan, M., Jefferies, M.G., Hicks, Ch. Manika, D., Dai, S. (2023). Zero-waste circular economy of plastic packaging: The bottlenecks and a way forward. *Sustainable Materials and Technologies*, Vol. 38.
16. *Ochrona środowiska w Polsce 2022 [Environmental protection in Poland 2022]*. Retrieved from: <https://stat.gov.pl/obszary-tematyczne/srodowisko-energia/srodowisko/ochrona-srodowiska-2022,1,23.html>, 22.09.2023.
17. *Packaging waste by waste management operations*. Retrieved from: https://ec.europa.eu/eurostat/databrowser/view/env_waspac/default/bar?lang=en, 10.09.2023.
18. Palazzo, M., Vollero, A., Siano, A. (2023). Intelligent packaging in the transition from linear to circular economy: Driving research in practice. *Journal of Cleaner Production*, Vol. 388, 135984.
19. Pinos, J., Hahladakis, J.N., Chen, H. (2022). Why is the generation of packaging waste from express deliveries a major problem? *Science of The Total Environment*, Vol. 830.
20. Song, G., Zhang, H., Duan, H., Xu, M. (2018). Packaging waste from food delivery in China's mega cities, *Resources, Conservation and Recycling*, Vol.130, pp. 226-227.
21. *Społeczeństwo informacyjne w Polsce 2022 [Information society in Poland 2022]*. Analizy Statystyczne [Statistical Analyses]. Warszawa: GUS [Warsaw, Central Statistical Office], p. 175.
22. Spruit, D., Almenar, E. (2021). First market study in e-commerce food packaging: Resources, performance, and trends. *Food Packaging and Shelf Life*, Vol. 29, 100698.
23. Su, Y., Duan, H., Wang, Z., Song, G., Kang, P., Chen, D. (2020). Characterizing the environmental impact of packaging materials for express delivery via life cycle assessment. *Journal of Cleaner Production*, Vol. 274, 122961.
24. Tokar, T., Jensen, R., Williams, B.D. (2021). A guide to the seen costs and unseen benefits of e-commerce. *Business Horizons*, Vol. 64, Iss. 3, pp. 323-332.
25. www.unilever.com/news/press-releases/2017/report-shows-a-third-of-consumers-prefer-sustainable-brands.html
26. Xie, G., Lijuan, H., Chrysostomos, A., Zuqing, H., Weiwei, C., Guokai, L. (2021). Assessing Consumer Preference for Overpackaging Solutions in E-Commerce. *International Journal of Environmental Research and Public Health*, Vol. 18, No. 15, 7951. <https://doi.org/10.3390/ijerph18157951>.
27. Yang, Y., Habib, K., Wood, M.O. (2023). Establishing best practices for E-commerce transport packaging waste management in Canada: A systematic review. *Journal of Cleaner Production*, Vol. 429, 139377.
28. Yin, L., Zhong, R.R., Wang, J. (2023). Ontology based package design in fresh E-Commerce logistics. *Expert Systems with Applications*, Vol. 212, 118783.