Journal of Engineering and Computer Sciences, Qassim University
Vol. 12, No. 2, pp. 16-30 (July 2019 /Dhu Al-Qi'dah 1440H)

Effective waste management by enhancing reusable packaging

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(Received 16/12/2019, accepted for publication 1/4/2020)

Abstract. Waste is an old dilemma for the environment and societies. This paper aims to propose an integrated method to reduce amount of waste packaging by enhancing reusable packaging in societies and industries. In the first phase, a System Dynamic (SD) method will be used for determining the interaction between the social aspects and reusable behaviour. The second phase will devote to exploring reusable packaging attributes by using Normal Average and Codes and Coding approaches. The last phase will conduct of a case study of a real company which needs to reduce waste packaging. Data was collected by evaluation of consumers' responses and experts' experiences as provided in the questionnaires. The results shown that a Social Behaviour Aspect Model (SBAM) demonstrated the importance of spreading the awareness of environmental behaviour to develop personal, social values and norms within communities. Moreover, a Reusable Packaging Attributes Model (RPAM) proved that the existence environmental packaging can help consumer to behave environmentally and reduce waste packaging. In conclusion, this paper can help government to investigate the most suitable approach for reduce the environmental impact of waste packaging by enhancing the use of reusable packaging within societies and industries.

***Keywords*:** Solid Waste, Environment, Packaging, Sustainability.

1. Introduction

The term 'waste' means different types of wastes such as food waste, packaging waste, manufacturing waste, etc. Countries' populations have increased dramatically during the last decade and this is continuing with the increasing influx of population year by year. Countries' environments are greatly affected by the increased population putting enormous pressure on limited resources and infrastructure. For example, North America produces a high amount of waste. This is because of the developed lifestyle, which leads to consumption of a large quantity of goods [1]. Countries become unable to deal with this population increase because of lack of technologies, economic crises, weak laws and policy, and poor social awareness about the issue. Waste in general has threatened the survival of humans and most types of plants and animals, as well as throttling all the natural resources that are necessary for human existence. Consequently, public concern has been raised over waste and pollution problems [2].

The Waste Framework Directive 2008/98/EC (the basic concepts about waste management) stated that it is important that waste management systems should consider general environmental protection principles such as sustainability of the environment, technical feasibility, economic viability, protection of resources, human health and social habits [3]. It is well known that inappropriate waste management produces both health hazards and environmental pollution [4]. Also, improper waste management methods impact directly and/or indirectly on people and animals, which spreads a lot of diseases between them [5]. In the last few decades, a multitude of human activities together with development of lifestyles and consumption patterns have resulted in the generation of a huge amount of different kinds of waste [6]. This includes non-clinical waste and clinical waste. Concern over the solid waste from health care facilities such as hospitals, clinics, pathology laboratories, pharmacies and other supported health care services has increased throughout the world [7]. The management of clinical waste is considered problematic due to the enormous amount generated, which causes a serious threat to human health. This type of clinical waste contains infectious waste, toxic chemicals and heavy metals, and also contains radioactive substances [8]. Also, there is a possibility of the pollution of non-clinical waste with infectious material during unsafe handling, collection, storage and transportation [9].

Dealing with waste packaging as a part of all waste is essential for the economy of every

country that faces the problem of increasing waste. The use of packaging is increasing and the annual production of packaging is also increasing. Packaging plastics, such as bags, sacks, wraps, containers for soft drinks and milk, as well as water containers and so on, represent the highest percentage of plastic solid waste [10]. China is considered the biggest producer of plastics at approximately 23.9% of world production; however, in Europe plastic production accounts for 20.4% of world production [11]. When analysing this huge amount of plastic production, Clark and Hardy [12] showed that packaging has accounted around for 37.2% of all plastics consumed in Europe, which is around 35% worldwide. In China, the volume of packaging materials is still increasing each year, and packaging waste represented approximately 15% of municipal solid waste [13] The main reason for this issue is that both the packaging waste recycling system and the composite packaging reuse technologies are undeveloped [14]. In Germany, two main problems still face packaging waste treatment. First, high costs accrue during the recycling process, and sometimes there are limited resources and willingness for environmental improvements. Second, there is uncertainty about the exact environmental improvements [15].

This paper will concentrate on packaging as a part of waste. This paper will look at reuse as an alternative option for reducing waste. This paper will not talk about reuse of material after recycling. However, it focuses on investigating reuse of customers' product packaging in a closed loop, where consumers can reuse the product packaging by returning it to the manufacturer, such as refillable packaging. Also, this paper concentrates on consumers' ability to reuse product packaging before disposal into a recycling bin or a rubbish bin, which would not return the packaging to the manufacturer after disposal, but it would delay disposal. Paying attention to increasing reuse practices amongst consumers and increasing the production of reusable products/packaging in industries is likely the best approach to solving the problems caused by growing piles of waste packaging. This paper aims to propose an integrated method to reduce amount of waste packaging by enhancing reusable packaging in societies and industries. This paper will consist of three phases. In the first phase of this paper a System Dynamic (SD) method will use for determining the interaction between the social aspects and reusable behaviour. The second phase of the paper was devoted to exploring reusable packaging attributes by Normal Average and Codes and Coding approaches. The last phase of the

paper is a case study of a real issue which needs to reduce waste packaging and increase the amount of reusable packaging uses.

2. Social Behaviour Aspect Model (SBAM)

Social Behaviour Aspect Model was designed by using SD method. The purpose of using SD method in this paper is to discover the interaction between variables in the real reuse behaviour and determinate the influence variables of attitudes and behaviour relating to reuse of packaging. SD links between the qualitative and quantitative models [16]. The SD method studies the knowledge of the real world and assesses the hypotheses and effectiveness of policy and can handle complex and nonlinear structures. SD consists of causal loop and stock flow diagrams in order to design SD model [17].

The social aspects are formulated SD model from a review of the literature and it identifies different aspects at different levels, i.e., Theory of Planning Behaviour (TOPB), Perceived Behaviour Control (PBC) and Cognitive Behaviour Theory (CBT). TOPB allows relationships among five relevant predictors identified in the existing research in the field of recycling: (a) the attitude towards the act; (b) subjective norms; (c) perceived behaviour control; (d) specific knowledge and communication; and (e) perceived convenience of the provided service [18]. This theory is concentrated on specific attitudes towards the behaviour rather than general attitudes. This theory does not consider the influence of social-demographic attributes. PBC demonstrates consumers' beliefs in terms of the difficulty and controllability of performing a specific behaviour [19]. CBT is the concept that understands the importance of behaviour changes; more specifically, the understanding of a participant's impact behaviours, and the negative beliefs that can make it particularly difficult for a participant to make positive behaviour change [20]. CBT combines cognitive and behavioural strategies to solve a variety of behavioural and psychological problems. The theory seeks to change a participant's irrational thinking and behaviours by educating the participant and reinforcing positive experiences that will lead to fundamental changes in the way that the participant copes. In other words, by learning to change thinking processes, participants can think more clearly about the choices they make and the behaviours in which they engage [21].

As illustrated in Figure 1, SBAM concentrates on three main parts: information, awareness-changing and behavioural adaptation rate for the three parts of CBT. The model identifies the variables that affect uninformed people so that they become informed about packaging reuse. This is achieved by enhancing general environmental concerns, perceived knowledge about packaging reuse, and personal and social values behind reuse of packaging which affect non-practitioners of packaging reuse. After that, the model continues investigation of what makes people become aware of reusing packaging. The model identifies that the influence from relatives and friends' norms with the effect of practitioners of packaging reuse can lead uninformed people to become aware of packaging reuse.

The last stage in the model is to investigate people's behavioural adaptation to become practitioners of reusing packaging. The behavioural adaptation rate is determined through the value of better conditions of product packaging and perceived convenience. As the change of consumers' behaviour from being non-informed about packaging reuse to becoming practitioners of reusing packaging could take more time, the model considers the delay function in information rate, awareness-changing rate and behavioural adaptation rate. The SD model used simple mathematical equations and some functions mathematical equations such as integration. Moreover, the model also focuses on the effect when someone who is uninformed about packaging reuse encounters someone who is a practitioner of packaging reuse. This leads to increasing the information rate, awareness-changing rate and behavioural adaptation rate. Having a combination of non-practitioners and practitioners of packaging reuse increases the influence of the latter in the area. This area depends on the total number of practitioners versus people uninformed about packaging reuse. In addition, the model is used time rate to influence information rate, awareness-changing rate and behavioural adaptation rate. Time rate is the amount of time to influence practitioners, which is calculated per day or per week. The domain experts in the area set the time rate for the basic model, which is 30 days.

In addition, after the model is completely constructed, it needs the set of approximate values in order to obtain an initial idea about its behaviour. These values were obtained from a questionnaire. The stock flow diagram also needs to define the interrelationships

with the whole model mathematically. The simulation output will be a graph explaining the relationship between the variables and time. The validation process is a very important task in order to test the model. According to Qudrat-Ullah and Seong's study [16], an SD model can be validated through various validation test steps including a boundary test, structure verification, dimension consistency, parameter verification, extreme conditions and structurally oriented behaviour test. Based on these tests, the model can be trusted and used for further simulation during the application of the empirical study.

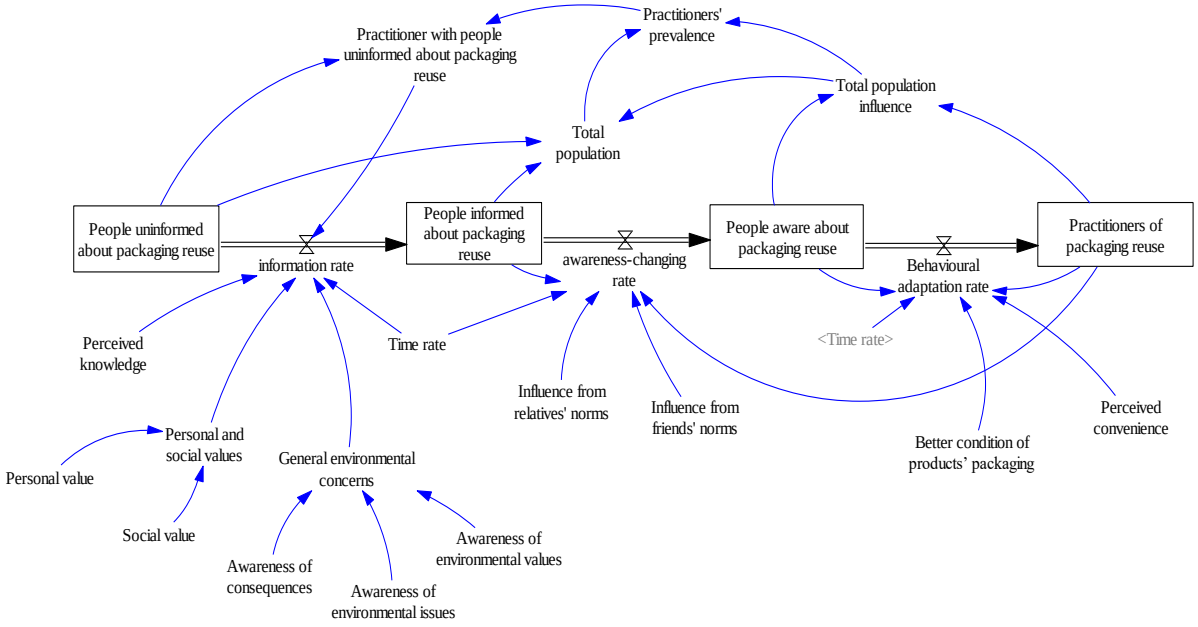

Fig. (1). Social Behaviour Aspect Model

3. Reusable Packaging Attributes Model (RPAM)

RPAM was designed by using Normal Average, Codes and Coding and factor analysis with Principal Component Analysis (PCA) methods. This section demonstrates all previous studies investigated packaging attributes with integrated approach. Due to the lack of researches to identify reusable packaging attributes, this section of paper combined comprehensive models that described packaging attributes from previous studies with integrated approach as following:

3.1 General Packaging Attributes

There are many researches study packaging design in different perspective. However, Azzi et al. [22] studied comprehensive investigation on most packaging design studies and found some failure in previous studies to address packaging design related to social sustainability and ergonomics. Then, Azzi et al. [22] designed conceptual framework of packaging design and outlined packaging attributes for signal use on five main aspects. The aspects are safety, ergonomics, sustainability, logistics, marketing and communication. These five aspects contribute to understand and analyse the efficient packaging design. The Azzi et al' model consists of four premises. The first states that the attributes of general packaging can implement for reusable packaging. The second states that it is inclusive, included all packaging life cycle attributes from cradle to grave. The third premises state that it is sustainable, considered the sustainability of packaging' attributes in whole life cycle which reflected the economic, social and environment benefits. The forth premises state that it is standard, considered general packaging, which could apply in designing reuse packaging.

3.2 Refillable packaging attributes

Refillable packaging is another possible solution to reduce the amount of waste packaging. Recently, a project conducted between Loughborough University and the Boots Company to investigate refillable packaging system in body wash product. The main aim of the project is to improve the sustainability performance and add value for female customers. In the early stage of study, the study outlined packaging attributes for refillable packaging for multi-use. The study has main premise that it is dedicated, determined some reuse packaging attributes especially refill from social point of view as there is lack of research try to find reusable packaging attributes.

3.3 Packaging attributes for reuse, recycle and composting

There is the only research that analysed reusable packaging attributes with the other type of waste tackles. The study conducted a real case in UK to determine how different design attributes packaging, with respect to reduce waste packaging can encourage and discourage the consumer in one of waste tackles such as reuse, recycle and composting. The study used visual questionnaire, digital diary and bin raids to obtain quick and easy observation and analysis [23]. The study outlined packaging attributes for facilitating

reuse, recycling and composting practice. The study has main premise that it is simulations and identified the main packaging attributes that consumers preferred from their practice. The Azzi et al' model, Lofthouse et al' study and Langley et al' study is only outlined packaging attributes form primary packaging perspective which leave the opportunity to research on secondary packaging attributes.

3. 4 Case Study on Secondary Packaging

The case study investigated packaging attributes on secondary packaging where no previous research studied. The case study highlighted the different between the real and imagine behaviour to reuse product' packaging and to understand the attributes that convinced to reused product' packaging on secondary packaging. By this step, the paper will pick the participants experiences carefully and analysis for identifying reusable packaging attributes. There are many kinds of multi-purposes packaging have recognised in people lifestyle during case study. Visual questionnaires approach was conducted based on a simple size of 100 households and of these 15 were completed the questionnaire and attached pictures but other rejected due to no attachment or uncompleted. The response rate was 15%. The reusable packaging examples photographed by participants was 25 types. The paper was discounted those packaging which have same functions. After understanding that people's reason behind reuse packaging, the interpretation on question of why they reused these packaging for other purposes are analysed for extract packaging attributes on secondary packaging. The paper found that the attributes of packaging that encourage people to reuse packaging for different purposes from case study come from geometry of packaging, the quality of packaging materials and content of packaging.

3.5 Reusable packaging attributes

After a comprehensive research was undertaken between packaging design attributes and reusable packaging attributes in an attempt to determine a set of common indicators, this paper generated a Reusable Packaging Attributes Model, which yielded a list of 24 attributes as shown in Figure 2. The RPAM set of 19 essential and set of 5 supplemental attributes are refined by experts' experiences. The RPAM includes several environmental, social and economic attributes.

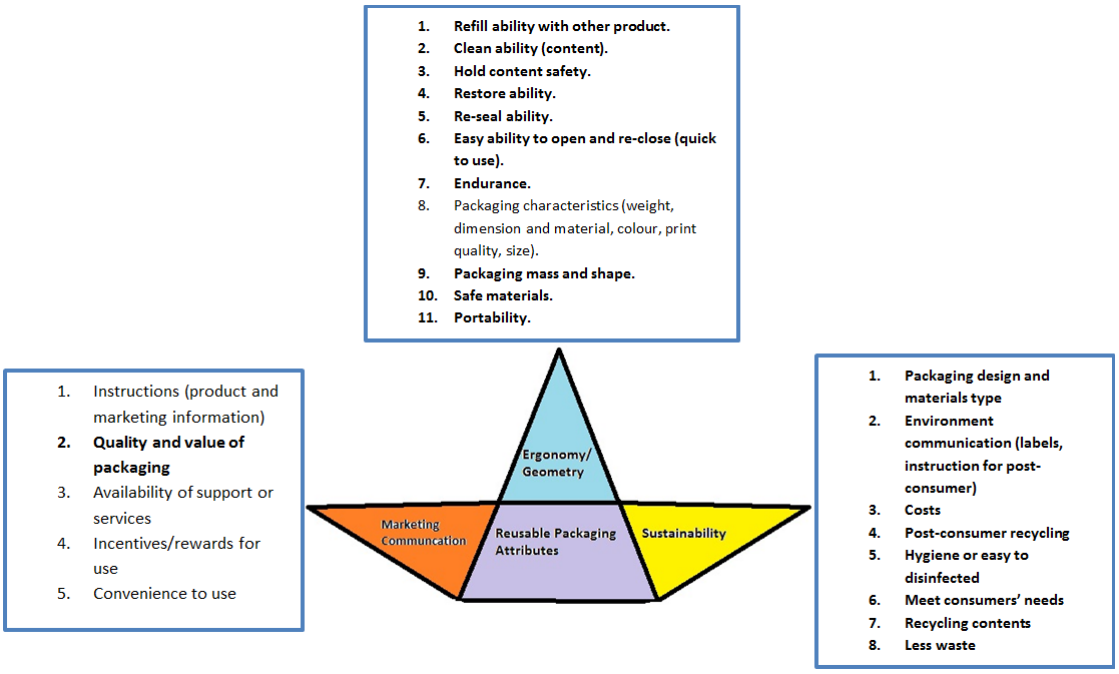

Fig. (2). Reusable packaging attributes Model (Bold attributes means essential attributes)

4. Case Study

Starbucks generates 4 billion paper cups a year [24] and most of them end of the landfill. From that, Starbucks introduced "for here" mugs in 2008 which allow the customer to reuse his own mug and can left it in the store with his name. However, Starbuck found there is barriers in "for here" mugs that it is difficult to track them. Then, Starbuck modified their goal in order to increase reusable cup activities in 2011 and 2012 to charge customers 10 % more for every paper cup they use whereas the customer who brought their own mug, they are going to get 10% off the price. However, the results shown that the percentage of beverages served in personal cups remained static [25]. Hence, Starbucks again amended their goal to increase the usage of personal cups by introducing reusable cups which are less expensive than other cups because it is made of a lighter material. The initial goal to increase the number of users of reusable cup by the end of 2015 to 25% but according to Berr [26] stated that due to the high percentage of number of sales in disposal cup which reach to 80%, it would make the program difficult to track them. So, the goal was later scaled back to increase the number of users of reusable cup

by the end of 2015 to 5%. It is £1 reusable cup and it launched in April 2013. According to Starbucks Company's official statement, it can be re-used thirty times. Unofficially, the cup's manufacturer has test washed cups over 170 times without any impact on performance [25]. In 2013, there are increasing of the number of customers who reuse their own cups from 49.9 million beverages compared with 2012 which was 38.8 million beverages which saving more than 1.4 million pounds of paper from landfills. The annual report shown that there is need for more improvement in order to achieve 5% increasing in the number of users of reusable cups.

As this paper concentrate on reusable packaging from various dimensions and have design a SBAM and RPAM in order to enhancing reusable packaging, this paper is going to implement Starbuck case and contribute to identify the possible solution for Starbucks company to continue growth the number of beverages served in reusable cups. This is achievable through look at customer's intension and behaviour toward reusable cup. In this stage, the paper will investigate the customers' behaviour and identify the drivers and barriers toward reusable cups. Then, the paper will look at developing reusable cup attributes from comparing the reusable cup attributes with reusable packaging model. In this stage, the paper will suggest some attributes could be added to current design which contributes to increase the number of customers use Starbucks reusable cups.

After analysing Starbucks reusable cup by using SBAM and RPAM, there are some recommendations that the paper come up with it through comparing Starbucks reusable cup with the results from the models. These recommendations can help Starbucks Company to reach into its goals to reduce the waste packaging and improve the reusable cup as following:

- Availability of recycling pin and reusable cup in stores. As Starbucks seeks to increase the recycling facilities in the stores through implementing Back-of-store recycling and Front-of-store recycling, they need to do more effort to meet their goal in the end of 2015 to have %100 recyclable bins in stores. Moreover, as it is noticed during case study the reusable cup did not available in all store which require more concentrate on availability of reusable cup in each store in order to increase knowledge about the cup and make the users more impulsive toward knowing or trying this cup.

- Increasing knowledge about the reusable cup, which is achievable through program, advertising, and competition amongst societies. Starbucks Company should educate the users about the importance of saving environment by demonstrate the current issues and number of the trash go to landfill every year. Then, the Starbucks Company should advertise about Starbucks reusable cups more in order to increase the knowledge and awareness about the new packaging design. This initiative will release millions of Starbucks advertisement that customers will notice them everywhere they go. The other way to increase knowledge about reusable cup through categorised loyalty card with the 10 pence of for each time the reusable cup refill, the idea of call new types of loyalty card which encourage customers to ask about it such as drives customer loyalty card or officer loyalty card. It contributes visual reminder the users who using car for example or in the office. This type of loyalty card or specific colour for each group will increase knowledge about reusable cup and how well the users remember to reuse it cup.

- Increase the influence of norms such as friends, parents and relative. This is achievable by run competition amongst customers in order to increase the influence non-user of Starbucks reusable cup form its friends, relative and parents who participate in this competition as Pizza hut did for its reusable box which call 'green box'.

- In packaging attributes, add three more attributes which could lead to increase the number of users in Starbucks reusable cup. As the analysis and discussion in previous section about the Starbucks reusable cup attributes compare it with reusable packaging attributes model. There are three more attributes which Starbucks should add them in the packaging. First, environment communication (labels, instruction for post-consumer), the Starbucks reusable cup should guide consumers on how reusable cup can save environment and how many trees can save if the customer use reusable cup. This information should be presented in attractive manner. Second, instructions, the Starbucks reusable cup should guide consumers on how to reuse the cup in term of the best way to clean the cup and some advice in how to store it, how many time can the customers reuse the reusable cup, is there any restriction of the type of drink could not use in this cups. These instructions should be in plain language and better place to present clear. This information on how to reuse reusable cup should be in an environmental manner to assist the consumers.

- Incentives/rewards for use, Starbucks Company should provide effective communication to users in order to encourage them to use reusable cup such as the rewards that come from saving money and announced the customer name in social media who helping to conserve the environment through certain activities.

5. Conclusion

Waste management systems concentrate on waste generation, collection, transfer, recovery and disposal, which can be a burden if there is an increase in the amount of waste generated and if there is also a poor waste management system. Waste management systems in many countries try hard to reduce the amount of waste in general and packaging specifically through various activities such as recycling, dumping, landfill, incineration, etc. Also, many regulations have been set in order to reduce the amount of waste packaging generation. Therefore, it is still necessary to focus on other activities that are currently paid less attention by industries and that have a smaller impact on the environment.

Reusable packaging is one of the solutions that can contribute to reducing the load on the waste management system and decrease the environmental impact of waste packaging. There are social, economic and environmental benefits of concentrating on reusable packaging, but it faces many challenges. In order to overcome the challenges, the paper designed SBAM and RPAM which contributed to enhancing reusable packaging amongst consumers and industries. The most important contribution was to establish the framework comprising the process, techniques and tools for structuring, discovering and analysing consumers' behaviour and attitudes towards reusable packaging. The proposed SBAM is in fact an objective way to handle subjective information in increasing the use of reusable packaging. This can help to reduce the environmental impact of waste packaging and take corrective and preventive actions at early stages to overcome the weaknesses of environmental behaviour. Additionally, the main managerial implication of the paper, which involves RPAM, is to help industries regarding how to effectively apply reusable thinking to non-reusable packaging, and it can help companies to better understand how they can convert their normal packaging or one-time packaging into reusable packaging. This can contribute to increase the number of environmental

packaging in the market. The case study contributes to confirm and elaborate on the results found in the SBAM and RPAM, which boosts the importance of the models and its implementation amongst societies and industries to reduce waste packaging.

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Journal of Engineering and Computer Sciences, Qassim University
Vol. 12, No. 2, pp. 16-30 (July 2019 /Dhu Al-Qi'dah 1440H)

ادارة فعالية النفايات من خلال تحسين التغليف والتعبئة القابلة لإعادة الاستخدام

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(قدم للنشر في 2019/12/16 وقبل للنشر في 2020/4/1)

ملخص البحث. النفايات هي معضلة قديمة للبيئة والمجتمعات. تهدف هذه الورقة إلى اقتراح طريقة متكاملة لتقليل كمية نفايات التغليف من خلال تعزيز التغليف القابل لإعادة الاستخدام في المجتمعات والمصانع. في المرحلة الأولى سيتم استخدام طريقة النظام الديناميكي (SD)وطريقة استخدام Normal Average لتحديد التفاعل بين الجوانب الاجتماعية والسلوك القابل لإعادة الاستخدام. في المرحلة الثانية سوف يتم استكشاف سمات التعبئة القابلة لإعادة الاستخدام عن طريق Codes و Coding. ستجري المرحلة الأخيرة دراسة حالة لشركة حقيقية تحتاج إلى تقليل نفايات التغليف. تم جمع البيانات عن طريق تقييم استجابات المستهلكين والخبراء على النحو المنصوص عليه في الاستبيانات. أظهرت النتائج أن نموذج السلوك الاجتماعي (SBAM)أظهر أهمية نشر الوعي بالسلوك البيئي لتطوير القيم والقواعد الشخصية والاجتماعية داخل المجتمعات. علاوة على ذلك ، أثبت نموذج سمات التغليف القابل لإعادة الاستخدام (RPAM)أن وجود التغليف البيئي يمكن أن يساعد المستهلك على التصرف بيئيًا وتقليل تغليف النفايات. في الختام ، يمكن أن تساعد هذه الورقة الدول في البحث عن النهج الأنسب لتقليل التأثير البيئي لتعبئة النفايات من خلال تعزيز استخدام العبوات القابلة لإعادة الاستخدام داخل المجتمعات والمصانع.