Effective waste management by enhancing reusable packaging

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ABSTRACT

This research aims to propose an integrated method, which combines all the aspects required to reduce environmental impact from waste packaging and to increase knowledge on the best way to enhance reusable packaging. Through a review of the extant literature, a conceptual framework was designed of the most important dimensions to enhance reusable packaging amongst society and industries The main contributions in the research are the development of a Social Behaviour Aspect Model (SBAM) and the creation of reusable packaging attributes checklist. The SBAM can help industries focus on having high knowledge about reuse of packaging and to cooperate with communities to develop personal and social values and norms during the designing of reusable packaging. SBAM is the output from the first phase, which showed the importance of making an effort to develop packaging for consumers to reuse. The reusable packaging attributes checklist can provide a guideline for manufacturers/designers who intend to develop packaging sustainability performance through designing reusable packaging, and contribute to meet and interpret the reuse of packaging requirements and procedures. It also determines the environmental impact of reusable packaging attributes, which many industries are concerned about. The reusable packaging attributes checklist is the output from the second and third phases. The System Dynamic (SD) method was the approach used to determinate the interaction between social aspects and reusable packaging. The Normal Average, Codes and Coding and factor analysis with Principal Component Analysis (PCA) approaches were used to determine the reusable packaging attributes checklist. The last phase of the research was the conduction of a case study of a real company which needs to increase the amount of reusable packaging it uses and which seeks to reduce its environmental impact. All methods used in this research have both a quantitative and a qualitative nature. Data was collected by evaluation of consumers' responses and experts' experiences, as provided in the questionnaires. This research opens up opportunities for improving packaging and meeting sustainable profits and provides valuable information based on social, economic and environmental benefits of reusable packaging. The novelty of this research can help industries to investigate the most important areas for development within communities to enhance the use of reusable packaging and also facilitate the process-based change from one-way packaging to reusable packaging effectively with reduction of environmental impact.

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ABBREVIATIONS

CBT	Cognitive Behaviour Theory
DfE	Design for the Environment
EMAS	Eco-Management and Audit Scheme
EPE	Environmental Performance Evaluation
EPR	Extended Producer Responsibility
EPS	Expanded Polystyrene
ESI	Environment Sustainability Index
FRS	Foundation for Reusable System
HIPS	High-Impact Polystyrene
KFC	Kentucky Fried Chicken
KMO	Kaiser-Meyer-Olkin
LCA	Life Cycle Assessment
LEED	Leadership in Energy and Environment Design
MSW	Municipal Solid Waste
NEP	New Environmental Paradigm
PBC	Perceived Behaviour Control
PCA	Principal Component Analysis
PE	Polyethylene
PET	Polyethylene Terephthalate
PVC	Polyvinyl Chloride
SAFE	Sustainability Assessment by Fuzzy Evaluation
SD	System Dynamic
SBAF	Social Behaviour Aspect Framework
SBAM	Social Behaviour Aspect Model
SPA	Sustainable Packaging Alliance
SPSS	Statistical Package for the Social Sciences
TOPB	Theory of Planning Behaviour

CHAPTER 1: Introduction

1.1 Background

1.1.1 Definition of solid waste

It is difficult to define solid waste because of its negative economic value but some regulations do include a definition; for example, the US Code of Federation Regulations defines solid waste as *'Garbage, refuse, sludge and other discarded solid materials from industrial and commercial operations and from community activities'* (Pichtel, 2005). In addition, in Singapore, the Environmental Public Health Act defines waste as *'any substance or article which requires to be disposed of as being broken, worn out, contaminated or otherwise spoiled, and for the purpose of this Act anything which is discarded or otherwise dealt with as if it were waste shall be presumed to be waste unless the contrary is proved'* (General's Chambers of Singapore,1987). In the Oxford Dictionary, it is defined as something which has no use or value. The lack of value can refer to mixed waste or the unknown composition of waste.

1.1.2 Categories of waste

There are a lot of types of waste, which are categorised under industrial, medical, commercial and social such as municipal solid waste, hazardous waste, industrial waste, medical waste, universal waste, construction waste, radioactive waste, mining waste and agricultural waste. A brief description of the most important types for the research aims is given as follows:

Municipal solid waste or domestic waste is defined by Chandrappa and Brown (2012) as "*the materials traditionally managed by municipalities, whether by burning, burying, recycling or composting*". Solid waste is generated within the community from several sources. Municipal solid waste contains durable goods, non-durable goods, containers and packaging, food wastes and yard wastes (Franklin Associates, 1998). Municipal Solid Waste (MSW) is often divided into two types: Garbage and Rubbish. Garbage contains plant and animal waste from consuming food; whereas, rubbish contains all the other components of MSW (Pichtel, 2005).

Industrial solid waste may contain solids, liquid and gas. It is divided into hazardous and non-hazardous waste. Hazardous waste may result from manufacturing or other industrial processes, for instance, coal combustion and flue gas. Hazardous waste must be treated in a specialist disposal facility. Non-hazardous industrial waste may contain everything left behind from the production of products or goods and it is usually treated in landfills (United States Environmental Protection Agency, 2012).

Medical waste denotes any waste generated from health care facilities such as hospitals, physicians, dentists, clinics and any medical laboratories. It includes anatomical waste, infectious waste, hazardous waste, and other waste. Medical waste is considered as hazardous waste, which is defined as not being components of municipal solid waste, but they are found particularly with medical resources and they are normally quite difficult to separate from MSW (Lee and Huffman, 1996).

1.1.3 Waste problems

The term ‘waste’ means different types of wastes such as food waste, packaging waste, manufacturing waste, etc. Globally, some countries have experienced dramatic population increases 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 (Marincovic *et al.*, 2008). 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. As a consequence, public concern has been raised over waste and pollution problems (Williams, 2005).

The Waste Framework Directive 2008/98/EC (the basic concepts about waste management) stated that it is important that waste management systems should take into account general environmental protection principles such as sustainability of the environment, technical feasibility, economic viability, protection of resources, human health and social habits (Council European Parliament, 2008). It is well known that

inappropriate waste management produces both health hazards and environmental pollution (Bdour *et al.*, 2007; Coker *et al.*, 2009). Also, improper waste management methods impact directly and/or indirectly on people and animals, which spreads a lot of diseases between them (Patwary *et al.*, 2009; Tamplin *et al.*, 2005). 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 (Oweis *et al.*, 2005). 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 (DenBos and Izadpanah, 2002). 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 (Bendjoudi *et al.*, 2009; Mohee, 2005). Diseases like cholera, dysentery, skin infections, and infectious hepatitis can become epidemic due to the mismanagement of some clinical solid waste (Pruss *et al.*, 1999; Coker *et al.*, 2009). Also, there is a possibility of the pollution of clinical waste with infectious material during unsafe handling, collection, storage and transportation (Shinee *et al.*, 2008; Saini *et al.*, 2004).

There is a large gap between waste generation and management systems. As a result, there is environmental pollution. Uncollected waste extends the environmental dilemma, which raises public frustration and public concern about generating waste. The key parameter in the assessment of the environmental impact associated with waste management is the mass flow of waste such as liquid, gas and solids. 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. In China, the volume of packaging materials is still increasing each year, and packaging waste represented approximately 15% of municipal solid waste (Jin *et al.*, 2008.) The main reason for this issue is that both the packaging waste recycling system and the composite packaging reuse technologies are undeveloped (Li *et al.*, 2005). 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 (Neumayer, 2000).

Materials are a significant topic when discussing waste. They play a vital role in terms of recycling and recovery. Some materials are extracted from oil derivatives such as plastics - a derivative of polymers. Plastics are used daily in life so there are several types of applications such as packaging, covers, bags and containers. 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 (United States Environmental Protection Agency, 2008). 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 (The European Plastics Industry, 2009). When analysing this huge amount of plastic production, Clark and Hardy (2004) showed that packaging has accounted around for 37.2% of all plastics consumed in Europe, which is around 35% worldwide. In addition, the materials that are found in compostable waste (which includes packaging and general waste) were formed by using elemental analysis (compostable waste contains the organic materials which are usually used as fertiliser). However, the rest of the materials contain an amount of nutrients. Also, CO_2 and NH_3 emissions produced after composting impair the natural environment (Banar *et al.*, 2009). Carbon dioxide emissions, which are emitted from factories during the manufacturing process, should be considered when discussing material pollution. For example, using electricity from oil-condensed power showed an increase in the emissions of carbon dioxide equivalents during the production phase (Thomsson, 1999; Williams and Wikström, 2011). A comparative study on milk packaging has been conducted in China (Xie *et al.*, 2011), and shows that the composites of the packaging category, such as PA-PE-Al laminate, a laminated foil made from paper and polyethylene, have a significant impact on the environment and this impact comes from the fossil fuels, land use and respiratory inorganics categories.

Moreover, there are other factors surrounding materials that also play a role in destroying the environment, such as the food waste that is still attached to its packaging and could have an effect on the environment. This issue could contribute to the impact of global warming by producing methane emissions (Williams and Wikström, 2011). If 1 kg of mixed household waste (packaging with its food) is composted in anaerobic conditions, the result will be that about 1.5 kg CO2-equiv/kg waste is produced (Lundie and Peters, 2005). Growing consumption has led to a rising amount of solid waste. The amount of waste is growing year by year. In previous studies, it was found that, out of

the 520 kg of household waste generated per capita in the EU in 2004, an average of 47% went to landfills (European Environment Agency's State-of-Environment, 2008; Williams and Wikström, 2011). Therefore, the prevention of food waste contributes to reducing CO_2 emissions by millions of tons of each year (Williams and Wikström, 2011; European Commission, 2008).

As shown from the literature, the waste produces a lot of problems for the environment and humans. Therefore, there is a clear need for more research into the solutions to gain a reduction in the waste. The solutions should be created not only for the immediate future, but also for future generations to follow, in order to achieve environmental sustainability. Therefore, this area of research needs to be examined further in order to discover the best way to solve the issue of increasing waste. Hence, it would also be of interest to investigate theories cited in the review of related literature and studies of the area of waste in order to discover the possible way to decrease the amount of waste, which would lead to a reduction in the environmental impact and close the gap between waste generation and waste management systems.

1.1.4 Waste management system

Solid waste management is concerned with generation, collection, transfer, recovery and disposal. Solid waste management is mainly the responsibility of local government, with regard to municipal waste. It is a very complex task which requires a lot of appropriate work between organisations and the private and public sectors. Gidarakos *et al.* (2005) defined waste management system as: *"the availability of reliable information about the quantity and the type of material being generated and an understanding about how much of that material that collection program managers can expect to prevent"*.

Public health and environmental protection can benefit highly from proper solid waste management. The main goal of a waste management system is to protect the health of the population by preservation of the natural environment from external impact. In addition, a proper waste management system promotes environmental quality and sustainability, improves economic productivity, and generates employment. Any other aims of the waste management system will still be categorised under the previous main aims. The poor waste management system could lead to a number of problems. Seik

(1997) reported that the lack of solid waste management can cause hazards to environmental health and give a negative impact on a country and may extend the impact wider than a particular geographical boundary.

1.1.5 The scope of a solid waste management system

After identifying the main objectives of a solid waste management system, it is time to identify the scope of a waste management system. Zurbrügg *et al.* (2012) reported that there are three elements that play an important role in developing a waste management system. They are classified as waste system, stakeholders, and the dimensions of the enabling environment. The objectives of a waste management system are to minimise waste generation by identifying the factors that lead to increase waste; to protect health and the environment by increasing the awareness of the importance of recycling and reuse; to develop the collection stage and integrate the transportation stage as well; and, finally, to manage the whole process and achieve the goals by providing proper services and improve organisations' performances.

Solid waste generation is increasing in developing countries owing to growing populations. Although there are various factors influencing solid waste generation systems, such as geographical and climatic conditions, population, economic income levels, and socio-cultural properties, the consideration of recycling economics and resource conservation options will contribute to developing countries being able to reduce the amounts of waste they generate. It is widely recognised that most of the countries around the world have unsatisfactory current waste management systems and they are trying to improve them. For instance, many of the industries in Finland deal with their waste by disposing of it in landfill rather than treating it (Aarnio and Hämäläinen, 2008); and in Australia there is the need to develop social motivation and organisational context in order to have a proper waste management system (Qian *et al.*, 2011). Most countries aggressively encourage recycling and other items go to sanitary landfill; and energy recovery techniques depend on their adaptation to particular characteristics of the political, organisational, social, economic and technical environment (Schübeler, 1996). However, according to Akinci *et al.* (2012), there are countries with developed economies that show a sustainable approach to solid waste management; and this has been achieved by reliable data on waste generation, standardising collection and transportation systems, and prompting proper recycling and

final disposal technologies. Depending on the technical, institutional, economic, and social limitations in the countries, they could face the serious problems that occur with a poor waste management system, such as irregular collection, informal scavenging activities, uncontrolled waste quantity and so on. An example of limitation on techniques, Seadon (2010) have reported some traditional strategies that have been used when dealing with waste management systems which have caused a lot of problems.

Therefore, it seems that it is important to determine appropriate methods for the safe management of waste and there are many researchers in developing countries who have investigated existing waste management systems. Having a successful waste management system will present a challenge in some countries due to insufficient financial investment, lack of awareness and effective control, absence of waste management guidelines and legislations, and unavailability of suitable treatment that could lead to further obstruction of waste management efforts. The key factor in controlling environmental impact associated with waste management systems is embodied by the need to reduce the amount of waste produced, which is not in equilibrium with the environment (Raffaello, 2012). Hence, developing a waste management system to reduce waste generation and conserve resources is essential with increasing population and per-capita income (Sufian and Bala, 2007). The question that remains is whether an alternative waste management system is capable of leading to a greater reduction of natural resources and energy; lower costs from an economic perspective; and, from an environmental perspective, the ability to reduce waste and contribute to building a green environment.

In the waste life cycle, there is a lot of hard work required from developing countries' governments to gain power over waste issues and provide the best way to manage the waste management system with the latest technologies in order to protect their countries. Hence, one important aspect of a waste management system that should be taken into account is to ensure the identification and classification of problem areas by proper techniques, which reduce the environmental impact of the waste management system, according to Banar *et al.* (2009). Moreover, investigating suitable methods for professional managers and operators of a waste management system is also an essential task. According to Schübeler (1996), having a proper waste management system with the three main elements (management process, generation process and handling process)

gives important aspects to a country in terms of political, social, economic and environmental factors, as follows (Schübeler, 1996):

- Political: The level of political influence in a waste management system is determined by the relationship between private institutions, government agencies and extent of citizens' participation in policy making, which all affect the character of management within the waste management system.
- Social: The level of social involvement is determined by the people's attitudes and patterns of waste handling within the waste management system.
- Economic: The level of economic development plays an important role in determining the waste treatment situation and influences waste management system services in terms of fees applied and quality of services.
- Environmental: The level of environmental quality is determined by designing a waste management system that is adapted to the physical characteristics of the area.

Therefore, it is essential to control all these elements and their issues in order to achieve the main goal of the waste management system and usefulness for political and economic reasons, and for organisations, society and the environment. However, the regulations that the countries implement have an impact on developing the waste management system in terms of increasing recovery rate (treatment waste) and reducing generation waste. In the next section, the research will present different regulations that most countries use in order to reduce the amount of waste.

1.1.6 Solutions for tackling general waste and waste packaging: Regulations

People and companies may not make any effort towards tackling environmental issues unless there are regulations to ensure green practices which do not give people and companies a choice but are a compulsory requirement. For instance, after local authorities across the United Kingdom initiated a recycling programme for householders and industries, the recycling rate reached 44.2% in 2013 (Local Authority Collected Waste Management, 2013). Due to government intervention and environmental compliance having a weak following amongst industries, some companies have avoided the task of being environmentally friendly through production, supply chain and socially. The other companies considered the environment but did not start any environmental

initiatives (Handfield *et al.*, 2005), although shareholders and investors believe that companies seeking to be green ultimately lead to competitiveness and improved economic performance (Rao and Holt, 2005; Rao, 2005). There are many advantages to setting up environmental regulation; as Reinhardt (1998) found, environmental regulation can eventually ensure environmental quality. Carter *et al.* (2000) claimed that proactive environmental policies such as designing green products and packages lead to conserving energy, reducing waste, recycling, and creating a corporate culture. Therefore, in the past, some scholars, such as Van Hoek (1999), called for examination of company ecological standards in order to reduce environmental damage. Other scholars claimed that companies that considered the ecological system should not only simply apply strategies as a type of compliance but it should drive the companies' financial performance (Klassen and McLaughlin, 1996).

There are many examples of national governments recognising the dangers to the environment from waste and then intervening to enhance ecological systems amongst industries. They tried to reduce waste amount and achieve environmental goals but they were not able to reach the ultimate goal. For instance, most countries established a system to involve the Extended Producer Responsibility (EPR) for collection, transfer and recovery stages. In Switzerland, the EPR system has been conducted on their e-waste (electronic waste such as electrical equipment) products from the point of sale unit to the end of a product's life. The main aim is to examine the long experience of using the EPR system, and its applicability in the area. The result showed that a nominal recycling fee is very important for increasing recycling rate (Khetriwal *et al.*, 2009). In Taiwan, the Taiwan Environmental Protection Administration launched a national EPR system. The main aim is to clarify the environmental effects of the recycling policy and apply that in the performance of the system. It is based on three main elements: collection rate, recycling rate and recovery rate. The task was to improve these three elements in the EPR system. The result was that collection rate was identified as the vital factor which determines recycling performance and increases the amount of recycling (Wen *et al.*, 2009).

In UK, a system to reduce waste called "Packaging Waste Recovery Notes" has been introduced. This Packaging Waste Recovery Notes system is under the EPR policies (Matsueda and Nagase, 2012). This intervention aims to meet the EU Directive's recycling target. The EU waste Framework Directive (2008/98/EC) targets the reduction

of negative externalities from landfill waste and limits the production through promoting recycling, reuse and other waste recovery (European Commission, 2014a). The packaging recycling rate reached 62% in 2007 (Advisory committee on packaging, 2011) and the UK government target is to achieve a 72.7% recycling rate by 2017 (Department of Environment Food and Rural Affairs, 2013). The UK government introduced "Compliance Schemes" which act between producers/retailers and recyclers to ensure that a certain amount of recycling of packaging is achieved based on the scale of business activities (Environment Agency, 2014). This regulation has influenced businesses with annual waste packaging of more than 50 tonnes and annual turnover of more than £2 million (National Packaging Waste Database, 2007). The results of government interventions and the increase in recycling subsidy have encouraged recycling activities and reduced the landfill issues in the area. In Germany, the government also intervened to encourage companies to produce ecological products and manage the life cycle of products through several acts of legislation which have been increased over the last few years, such as end of life, take back and closed-loop resource management laws (Thun and Müller, 2010; Toffel, 2003).

With regard to the packaging industry, initiatives in waste management have centred on packaging; for example, in 1991, Germany set up additional regulations for industries which stipulated mandatory recycling for packaging in order to reduce the environmental impact. In 1992, the Commission of the European Communities put forward a regulation for a packaging directive which stated that the producer has a responsibility for packaging from production until disposal (Organisation for Economic Co-operation and Development, 1991). Some provinces in Canada imposed a ban on non-refillable beer bottles; some enacted a process called half-back deposit and others applied a tax on non-refillable bottles (Rowe and Platt, 2002). In Portugal in 2004, the European Directives for waste management systems, such as packaging, set the required targets with which industries had to fully comply. Industries had to obey packaging recycling targets by 2011. (Council European Parliament, 2004; Pires *et al.*, 2011). Furthermore, the prevention study programme which was conducted in Denmark in order to reduce environmental impact from harmless materials such as food, paper, and packaging has reduced the amount of waste generation (Gentil *et al.*, 2011). As shown in the literature review, these government interventions led to improve waste management systems through reduction in waste generation and increasing the waste treatment such as recycling.

Most legislation, which is designed by governments, concentrates on the polluter-pays principle. This means that the polluter has the responsibility for its negative environmental influences, and forces companies to think about implementing an ecological system within their business. As responsibility falls on the producer or manufacturer, producers were encouraged to think of alternative ways of reducing the amount of waste, such as subsidies for recyclable design (Fullerton and Wu, 1998). Therefore, some polices were set up in order to assure that the industries produce products and packaging supporting the environment and reducing the negative impact. For instance, the EPR policies provide incentives for producers to "Design for the Environment" (DfE), which is the important issue for environmental policymakers (Calcott and Walls, 2005). Without DfE, EPR policies cannot accomplish environmental targets (Walls, 2003). DfE requires incentives for designing green products such as recyclable products, deposit and refund scheme (Calcott and Walls, 2005).

The original idea of DfE came from Victor Papanek in 1974 when he wrote a book about the designers' obligations towards society and environment (Lewis and Gertakis, 2001). He observed that designers concentrated on style and aesthetics rather than social and environment impact. Lenox *et al.* (1996) investigated DfE practices with a team to study the pattern of adoption of DfE practices in US manufacturing. Lenox *et al.* (1996) found that the adoption of DfE is dependent on ability to facilitate DfE within organisations and deep understanding of DfE. The first scholars to address DfE in an economic model were Fullerton and Wu (1998), then Choe and Fraser (2001) extended Fullerton and Wu's model to include household waste. They found industries that use primary and recycled inputs to produce green products should have two expected outputs: packaging per product and degree of recyclability. Hence, many studies have investigated the importance of DfE in compliance with environmental initiatives. For instance, Chen and Sheu (2009) found increasing government regulation standards towards the environment would gradually improve DfE and, on the other hand, promote EPR. The relationship between regulations and DfE activities has been studied (Gottberg *et al.*, 2006), which encourages many industries to invest a large portion of their efforts in DfE activities.

Hence, there are many industrial sectors that include environmental initiatives in their products, such as electrical/electronic industries, automobile industries, thermal power industries and others. For instance, Nippon Steel is developing steel production with zero waste, reducing CO_2 emissions and energy consumption, recycling and waste reduction and environmental protection and improvement (Kawai, 2001). Nokia Multimedia Terminals carried out designing of environmental satellite receivers as a type of compliance with legislation (Nilsson and Bjorkman, 1999). In Taiwan, there were many efforts made by manufacturers in order to develop their activity in environmental design to reduce use of energy (Tien el al., 2002). If the industries' activities towards the environment through their compliance with the legislation match the competitiveness amongst them, it would provide better results and lead to reducing the environmental dilemma. According to Porter and Linde (1995), the industrial activities must be developed not only to achieve sustainability and eco-efficiency but for the companies to be competitive as well. Environmental initiatives and actions from companies could be directed towards the reduction of waste in general and packaging specifically, which would reduce the negative environmental effects. Supporting and funding organisations that are involved in environmental initiatives may also indirectly advance these initiatives and lead to the achievement of environmentally beneficial results. Therefore, the key issue of legislative intervention from governments and of providing ecological programmes' initiatives from industries is concentrating on the eco-oriented life cycle of products from extraction of raw materials until disposal. This will lead to great improvement in the environment if there is competition amongst the companies when they implement ecological alignment.

Hence, as the literature shows, current attention on waste concentrates on evaluating and analysing the policies that play an important role in this area from an economic perspective. Therefore, it is necessary to indicate a clear need for investigating waste treatment in order to discover whether it can make a reduction in the waste or it would increase the load of waste management systems and increase the effect on the environment.

1.1.7 Waste-tackling techniques

The treatment of waste techniques is one of the most researched concepts in engineering literature. A significant number of studies have examined the various dimensions of

waste treatment techniques and a vast array of other variables. According to Manga *et al.* (2011), there are potential benefits from recovering materials from the waste stream, which contributes to resource efficiencies and reduces the waste quantities. In Finland, research found out that theoretical and actual recovery rates had potential for reducing packaging waste. The result shows that packaging waste is highly recoverable, but the recovery rate is still low, which presented 34% of packaging waste, because of the weakness of the collection rate (Aarnio and Hämäläinen, 2008).

Disposal is the last stage in the life cycle of waste and, as well, is the essential stage in the success of the waste management system within any area. As long as there are efforts applied to control all the initial stages of the waste life cycle (waste generation, store, collection, and transportation), it is still this disposal stage that has significant value to the system, whereby good treatment methods after disposal mean good results for countries. Treatment facilities can be categorised into desirable and undesirable. The desirable approaches are recycling, material recovery and re-use; whereas undesirable approaches are dump sites, landfills, chemical plants, incineration, etc. Therefore, the main goal of the disposal stage is to discard the waste by modern methods in order to obtain the waste management system target. In this section, the research will focus on the typical approaches that are used in the majority of developed countries and developing countries. Without doubt, there are a lot of approaches used during waste treatment but the research will deal with open dump and burning, recycling, landfill and incineration in terms of the main factors that play vital roles to increase the desirability of these treatment approaches. The research will briefly mention the disadvantages of these approaches besides the advantages when they are used correctly.

In addition, lots of problems occur in each of the traditional solutions that deal with waste management – such as open dump and open burning, landfill, and incineration – which lead to effects on human health and the environment. Open dump is the most common method used by most developing countries (Al-Khatib and Sato, 2009). This method has a great advantage: it is less expensive than other methods. However, open dumping has been recognised as a potential infection source for public health and environmental pollution. The main reason for this is that it is uncontrolled and some waste could transmit diseases into the environment either via different types of direct contact, such as wounds, inhalation and ingestion, or via indirect contact through the food chain or through leakages from underneath the dump; or the surface might consist of heavy metals and other organic pollutants, which leads to contamination of surface

and groundwater resources (Al-Khatib and Sato, 2009; Eggen *et al.*, 2010; Öman and Junestedt, 2008). Also, wind could easily blow over the dumped waste and disperse air-borne pollutants into the environment. According to Manga *et al.* (2011), the disposal of health care waste in open dumps without adequate design considerations that guarantee the protection of the environment might cause serious health and environmental hazards.

The recycling of waste is a priority in most developed countries' waste hierarchy and is often explicitly targeted by states or local public authorities when dealing with environmental issues. The main goal of recycling activities is to allow the production of the secondary materials which can be used instead of primary materials. This technique saves money, reduces the production of new material and reduces environmental impact. For instance, in Turkey, a study showed that the best way to reduce environmental impact is to recycle materials and compost organic materials (Banar *et al.*, 2009). However, some developing countries do not use the recycling approach as a main treatment method due to the fact that it becomes expensive and also it requires a lot of energy. The two factors that interactively increase the cost of the recycling process are collection and handling processes. There are different waste collection schemes used in the recycling process. The selection efficiencies play an essential role in the recycling process (after the collection phase) and are the parameter that measures the amount of materials which are sent to recovery. Actually, it is segregation of the materials in terms of recycling or non-recycling, in which non-recycling goes to landfill or other approaches, whereas the recycling materials go to the next stage of the recycling process. In fact, inappropriate separation of materials at the recovery stage before being sent to be reprocessed gives an undesirable result (Rigamonti *et al.*, 2009). However, appropriate separation of materials can give an advantage from an economic perspective from knowing the amount of waste that goes to recycling and how much it costs.

The handling processes also makes recycling undesirable in some industries. According to Rigamonti *et al.* (2010), reprocessing efficiency also plays an important role in the recycling process. This means that all material should have a high efficiency level during melting, which presents a good result. For instance, steel melting efficiency is 90% during furnace (Rigamonti *et al.*, 2010). Therefore, the overall performance of recycling is dependent on multiplying selection efficiency with reprocessing. It is worth mentioning that the quality of materials produced after recycling changes. Rigamonti *et al.* (2009) reported during their experimental work on paper, wood and plastic that

recycling materials lose some of their properties. For instance, recycled material cannot be freely coloured and also there are some side effects, e.g. smell.

Landfill in general, as shown in previous life cycle analysis, is another easy and low-cost way to dispose of waste. Landfill is an isolated area of land that receives household waste or other types of waste. Despite the use of recyclables becoming worldwide, landfill remains the most common treatment method because it is simple and inexpensive. Landfill is the commonest option for general waste disposal methods. It is also used as a secondary option for other waste disposal methods. The main three waste products produced from landfill are solids, liquid and gas – which may pollute the three principal features of the environment: atmosphere, hydrosphere and lithosphere (Hossain *et al.*, 2011). The main problems impacting on health arise from landfill gas, which consists of methane and carbon dioxide, and exposure to groundwater contaminated by landfill leakage (Williams, 2005). Therefore, it is extremely important to think about a proper healthy landfill treatment in order to minimise the risk to the environment and human health. In Turkey, government set target ratios to reduce the amount of biodegradable waste that will be sent to the landfill areas by up to 50% by the end of 2014 (Akinci *et al.*, 2012). In the UK, there were more than 2000 landfills in April 2004 but, by December 2009, there were only 465 (Environment Agency, 2010). In the US in 2008, 54% of waste generated was landfilled (United States Environmental Protection Agency, 2009); while in Australia in 2002 about 70% of waste was moved to landfills (Productivity Commission, 2006). Therefore, if a landfill is not properly managed, not injected well and the surface not impounded, it will increase human health risks and environmental pollution concerns.

In landfill sites, the factors that may influence the waste management are collection stage, population density and polices. The collection stage plays an essential role in landfill sites, in which good collection services with segregation of waste (consumption type) enable the proper management of landfill sites. If there is a low rate of collection, it will be difficult to reach the landfill objective of protecting both people's health and the environment. Population density is another issue which faces landfill sites. Some recent landfill does not accept huge amounts of waste and some countries close landfill sites and others operate new sites in order to deal with the amount of waste. Besides increasing population density, changing lifestyle also plays a role in increasing solid waste (Eskandari *et al.*, 2012). Mazzanti *et al.* (2009) highlighted that landfill diversion

is driven by environmental factors, as well as the cost linked to population density and the sharing of the separated collection. Mazzanti and Zoboli (2008) also stated that increasing landfill is associated with increasing consistently with social income, and economic and environmental costs. Policies also have a role in landfill site separation and prevention, such as avoiding wetlands, away from fault areas, away from seismic zones, away from unstable areas and avoiding airport areas (Pichtel, 2005; Mazzanti and Zoboli, 2008). Sanitary landfill, which requires careful isolation of waste so that it does not cause significant negative health effects, meets environmental legislations and reduces the undesired impact on current waste management system, is required. According to Cossu (2012) reported that modern landfill design should be more effective and have environmentally sustainable strategies in order to minimise the risk to the environment. Moreover, Siddiqui *et al.* (2012) suggested that pre-treatment of landfill by mechanical-biological treatment is a viable option in waste management for reducing the gas generation, leachate strength and waste settlement.

Incineration is a high-temperature dry oxidation process that converts waste into ash and gases. It is particularly useful in the treatment of some 'sharps' waste and dangerous waste as well. This process is usually used to treat waste that cannot be recycled, reused, or disposed of in a landfill site. Incineration emits lots of harmful pollutants including carbon monoxide, hydrogen, chloride, and metals (Coker *et al.*, 2009; Pleus and Kelly, 1996). Another distinct concern is the risk of infectious diseases from the emission from gases and the ash, even if the most modern incineration plant is used (Pleus and Kelly, 1996). Incineration is an inappropriate way to dispose of waste for most developing countries, due to high cost requirements (Coker *et al.*, 2009). However, it is still necessary to dispose of some quantity of ash and unburned waste, especially at landfill sites. Dugenest *et al.* (1999) conducted a study to determine viable micro-organisms in the municipal solid waste incinerator. The study reported that bottom ash contained a lot of micro-organisms and this increased for about five months after the ash had been deposited. However, there are some developed countries which still increased incineration capacity due to the acceptance of mixed waste and energy recovery (Eriksson *et al.*, 2005). The successful incineration of waste depends on the form of collection containers, maintenance support, acceptable energy sources, and understandable operational instructions (Rogers and Brent, 2006).

By reviewing the majority of waste-tackling techniques used, it seems that there are advantages of using these techniques if they are used in a proper way; otherwise, it would not be useful for the environment and not benefit waste management systems. Hence, the research will look at the other approach, which is reuse, and discover whether it can be option to contribute to reducing waste if it is implemented in the proper way or if it does not make that much difference. The next sections will address reuse in terms of concepts, history and recent activities.

1.2 Justification for the research

It is obvious that waste is a significant topic which needs to be investigated in order to explore new ways to save our environment from the huge amount of waste generated. This thesis will concentrate on packaging as a part of waste. One-way packaging is dominant and travels the old route from the consumers directly to municipal household waste dumpsites or incineration plants. This thesis will look at reuse as an alternative option for reducing waste. This thesis 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 thesis 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.

Looking at previous studies, it is clear that there is no comprehensive study about reuse from a variety of perspectives. However, this research approach aims to close the gap between consumers and businesses by investigating reusable packaging specifically in order to encourage consumers to use reusable packaging and businesses to design reusable packaging. The research interventions in these issues will focus on demonstrating innovative models by enhancing the reuse of packaging from society and industry points of view. This contribution will encourage reduction of the burden of environmental impact, which reduces the amount of waste that enters into the waste management system, and encourages the system to obtain its goals and objectives. Therefore, reuse is a possible recent solution due to the opportunities to provide a range of economic, social and environmental benefits in different areas of the life cycle.

1.3 Research questions

The following questions will be answered at the end of the research:

- What are the most influential factors contributing to changing community behaviour and attitudes towards reusable packaging?
- What is the main effect of developing design guidelines/internal design in the manufacturing process to enhance the reuse of packaging?
- What are the environmental impact of producing reusable packaging?

1.4 Research aim and objectives

This research study seeks to investigate how to move from one-way packaging into reuse of packaging as an alternative solution to reduce waste. Reuse of packaging has been correlated with several dimensions; however, there seems to be a lack of research on them. This is partly because there is high dependence on the current treatment techniques. The European standard 'BS EN 13429:2004 reuse of packaging', which consists of four main requirements, is still not able to convince the industries to move to reusable packaging. Hence, the main aim of the research is to propose an integrated method to reduce environmental impact from waste packaging and to increase knowledge on the best way to enhance reusable packaging. The main objectives are:

- To analyse the solid waste management system and regulations, and review the waste treatment practices in order to find out the key factors for decreasing waste.
- To develop a framework in order to enhance reusable packaging amongst society and industry for the benefit of the environment.
- To investigate consumers' orientation including consumers' intention and behaviour towards reusable packaging.
- To explore the reusable packaging attributes including internal design (design procedure) and design guidelines.

- To investigate environmental impact of producing reusable packaging through its attributes, which will enhance identification of how to save resources and bring savings to businesses and environment.
- To conduct a case study to demonstrate the above conceptual framework.

1.5 The scope of the research

The research scope in this framework are as follows:

- Packaging is a suitable example to demonstrate the reuse of waste because of the flexibility of packaging that is designed to be reused, and the research is going to apply packaging in the conceptual framework.
- The types of packaging that the research is going to investigate are primary packaging (packaging around individual items, e.g. a bottle holding water) and secondary packaging (packaging surrounding products for storage or display, e.g. a cardboard box).
- The research will concentrate on the production stage of designing reusable packaging in terms of design guidelines and environmental impact of implementing attributes, and the research also will focus on the customer stage in order to identify the main aspects influencing consumers' orientation.

1.6 Achievement of the research

The achievement of the research will be the development of a comprehensive framework which includes a SD model enabling industrial professionals to identify the factors that influence customers' behaviour and intentions towards reusable packaging. Another achievement will be a reusable packaging attributes checklist enabling industrial professionals to assess the existing reusable packaging or use it as a guideline during designing reusable packaging in their production line. Moreover, the reusable packaging attributes checklist provide a practical tool for industries in the application of attributes that can impact the environmental.

1.7 Thesis structure

This thesis has followed a common research and reporting structure, as follows:

Chapter 1 corresponds to research background about waste issues and its impact for humans and the environment. Justification for the research is explained and then research questions are generated to ensure that the research objectives are met. The conceptual framework and structure of the thesis are explained.

Chapter 2 is the literature review and is used to identify the social, economic and environmental benefits of a reuse approach. The literature review also reviews people's behaviour and attention towards waste tackling in order to identify major drivers of reuse behaviour. In addition, the literature review intensively reviews the packaging attributes and environmental impact of new packaging design in order to discover reusable packaging attributes and the environmental impact of this new packaging.

Chapter 3 is the methodology chapter. In order to identify how to enhance reusable packaging amongst societies and industries, an appropriate research methodology was defined. The proposed research methodology is used to analyse and handle each phase of the defined conceptual framework.

Chapter 4 is the first phase of the conceptual framework. An SD method is used for determining the relationship between social aspects and reusable packaging. This will lead to the design of a social aspects model.

Chapter 5 is the second phase of the conceptual framework, in which qualitative and quantitative methods are used for determining a reusable packaging attributes checklist.

Chapter 6 is the third phase of the conceptual framework. PCA method is used for discovering the relationship between reusable packaging attributes and environmental impact.

Chapter 7 is a case study of a real company which needs to increase the amount of reusable packaging amongst its customers and also seeks to reduce one-way packaging.

Chapter 8 explains the research conclusions and contribution to knowledge regarding reusable packaging and environment impact. Additional suggestions for further research are recommended.

CHAPTER 2: Literature review

2.1 Reuse

2.1.1 The concepts of reuse

As this research concentrates on waste packaging, according to Packaging Waste Directive 94/62/EC the term 'reuse' is defined (Environmental Regulations, 2005) as an:

"Operation by which packaging, which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations, is refilled or used for the same purpose for which it was conceived with or without the support of auxiliary products present on the market enabling the packaging to be refilled: such reused packaging will become packaging waste when no longer subject to reuse"

Also, according to European standard BS En 13429:2004 the term 'reusable packaging' is defined (British Standards Institution, 2004) as a: "*Packaging component which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations in a system for reuse*"

In recent years, reusable packaging has been a success for many kinds of waste issues to which a lot of research has made efforts to find a solution, such as high volume of solid waste, frequency of product damage, inefficient storage or warehouse space, worker safety, ergonomic issues and hygiene demand. The research conducted by the Foundation for Reusable Systems (FRS) assessed whether disposable or reusable packaging can save food from spoilage (Karst, 2013) and found that reusable packaging has an advantage of reducing the amount of packaging going to waste schemes and recycling processes. This also decreased the load on waste management systems. The main components examined were food safety, freshness and the quality of food. In addition, the results found that there is a significantly lower rate of damage for reusable packaging due to its strength, consistent size and compatibility compared to one-way

packaging. Also, the damage rate decreased fourfold in retail distribution. In product quality, the FRS concluded that there is a quality difference between disposable and reusable packaging (Karst, 2013). In England and Wales, the regulations rank the priority for waste management options according to what is the best for the environment. Priority is given when the waste is generated for 'preparing for re-use' then recycling, recovery and, finally, disposal (Department of Environment, Food and Rural Affairs, 2011).

2.2 Social, economic and environment benefits of reuse

Reuse is one possible approach that could play an important role to achieve waste reduction if it is diffused in the right way and for a long period time. The reuse process considers each step of the waste life cycle; however, the recycling process deals with the issue of waste from a technical and economic perspective. For example, the environmental impact of recycling paper has been shown by a study in the Chinese paper industry (Wang and Hua, 2006), where there were increased fossil fuel consumption and emissions of greenhouse gases, and it seems difficult to contribute sustainably to reaching an ambitious goal if the emphasis is on recycling rather than on avoidance or reduction of waste. According to The Industry Council for Packaging and the Environment (2009), reuse has several advantages for the environment, as follows:

- Optimising the use of material.
- Minimising waste production and increasing second use.
- Minimising waste of material and energy.
- Conservation of fossil fuels.
- Minimising Carbon dioxide (CO2).
- Minimising Nitrogen oxides (Nox).
- Minimising several elements of environmental impact.

Solid wastes contain significant amounts of valuable materials like steel, aluminium, copper and other metals. If these materials are reused, it reduces the volume of the wastes going through to landfill. In addition, better innovative approaches will help save valuable natural resources and turn wastes into useful products. Therefore, the goal of considering reuse within waste management systems is to deliver what consumers want, with good quality and services which contribute to increasing the reuse of the items several times. In society, reuse is important to people's lifestyle. Reuse has been recognised in a range of product packaging. Consumers prefer to reuse rather than throw

something away if they find their product packaging can be reused. Reuse imparts a perception of higher value at the end of product packaging life. Reuse can save consumers money, increase environmental responsibility amongst society, save time and effort, conserve the environment, reduce resource consumption, develop waste management systems, and relieve the load on waste management systems due to the reduction in waste volume, which leads to cleaner communities. Consumers' perception of reusing product packaging could come from product packaging functionality, which encourages reusing product packaging for other purposes such as refill or re-storing materials. Alwaeli (2010) suggests that consumers place more demand on functional features of packaging to fulfil their need to reuse. Langley *et al.* (2011) confirmed that any products that fall into the reuse route were not thought of as waste by consumers and low-value format product packaging that has no obvious secondary function is likely to be discarded into the bin.

The most benefit for industries to implement reusable pallets is to obtain a sustainable supply chain process, which returns a financial profit to the company, a safe work atmosphere and saves the environment. There is a wide range of reusable packaging used in logistics for efficient storage, handling and distribution, such as reusable pallets, hand-held containers and bulk containers. Some companies have implemented a green closed-loop system which specifically focuses on reusable pallets. Reusable pallets in logistics is designed for multiple trips and extended packaging life. Reusable pallets provides a rapid return on investment, low shipping and labour costs, better product production, high productive flow, better ergonomics for packaging, develops worker safety, reduces waste management system costs through decreasing the load on the waste management system, and improves the quality of work. Recently, there have been some attempts to show the benefits of implementing a reusable packaging scheme, according to an article published in Packaging Europe News in June 2013 which showed the Bosal company used very large metal containers in logistics, which led to poor transport capacity utilisation. When Bosal implemented reusable packaging, made from recyclable plastic, the company saved 37 working hours per week in transportation between manufacturing plants and factories, and also saved money in return transportation of empty metal containers (Packaging Europe, 2013).

In addition, Amatech is a reusable packaging manufacturer which focuses on product distribution, and the company is expanding efforts to provide industries with reusable

packaging. Amatech found implementing a reusable packaging programme has been proven to reduce costs throughout the supply chain in terms of waste produced, damage to products, labour costs and inventory. Amatech found that reusable packaging could reduce costs during distribution, drive sustainability and optimise consumer delivery (Amatech, 2013). Firms' revenues can be positively affected if there is increasing demand for environmental products, as stated by Carter *et al.* (2000). Also, Klassen and McLaughlin (1996) found that the financial performance of the firm is affected by environmental performance through the market. Hence, implementing reusable packaging could be a possible way in environmental management in order to maintain markets in the long run.

Cost effectiveness in various forms such as economic analysis has been discussed for solid waste management systems in industrialised regions. A combination of the escalating need for environmental products and the negative results of the disposal of their materials has led manufacturers to consider reuse to minimise the consumption of resources and energy. If reuse leads to reduction of the unit cost going into the waste management system, there will be a demand for its use, which will give the advantage to the whole waste management system to achieve its goals and objectives. The number of times a product/packaging can be reused will help to decide cost factors and minimise any additional cost for recycling, waste disposal and management (Dubiel, 1996). Reuse is the simplest, most economical way to treat one-way packaging that is more favourable to consumers and manufacturers. However, in industry, reuse has become an important and necessary element of a closed-loop distribution network, which results in cost savings and environmental benefits. It is expected that reuse in industry will continue to become a viable alternative to one-way packaging (Dubiel, 1996). Durability, product protection from damage, and repeated use are important characteristics that should be taken into account for a well-designed product. Therefore, ergonomic design features allow savings in warehouse space and contribute to reduced logistical operation costs during transportation and storage. Although a reusable product might be built with thickness twice that of a single-use product, a multi-use product can compensate the cost with increased utilisation and the reduction of overall materials' consumption. Therefore, reuse is a significant saving for materials and manufacturing, and for the collection, operation and disposal operation (Jarupan *et al.*, 2011).

The cost of the reuse approach is broken down into different criteria. Firstly, material cost consists of all product components required to design a new reusable product, such as cost of product accessories and cost for product material. Secondly, manufacturing cost includes all product manufacturing, remanufacturing costs, cost for machines, cost for tools, cost for energy, and may apply to both new and reused product components. Thirdly, assembly cost relates to the processing time for assembly of the product. Fourthly, recovery cost includes bringing back cost to the manufacturing facility, including transportation, handling, and labour costs. Fifthly, disassembly cost includes the cost of disassembly time when recovering product components for reuse, recycle, or disposal. Sixthly, maintenance for reuse cost can be applied only to the components that are reused. It includes costs for cleaning, repairing, and inspection. Seventhly, recycle cost only applies to recyclable components after they have been used. Finally, disposal cost applies only to those product components that are to be discarded at the end of life (Jarupan *et al.*, 2011).

In order to design a robust investigation into reuse, it is essential to investigate the social behaviour and attention of people towards reuse. After that, an investigation should be carried out to discover the reusable packaging's attributes followed by its environmental impact in order to encourage industries to design reusable packaging. In the following section, the research will look at the social behaviour and attention towards reuse, the importance of packaging design for reuse and the environmental impact of designing the reusable packaging.

2.3 Social behaviour and attention toward reuse

A lot of research has been conducted in the area of general behaviour and attitudes on waste. For example, on studying influencing households' participation in recycling, Vicente and Reis (2008) found that when looking at behaviour towards recycling it is more essential to concentrate on incentives to explain households' intent to participate in recycling. Also, there are examples including analysing attitudes towards household waste (Barr *et al.*, 2001a); differences between reduction, reuse and recycling behaviour (Barr *et al.*, 2001b); impact of norms and consequences on recycling behaviour (Bratt, 1999); factors influencing household waste recycling behaviour (Chu and Chiu, 2003); psychological aspects of recycling (DeYoung, 1986); recycling attitudes and correlates (Larsen, 1995); individual and social attitudes towards waste incinerator (Ferreira da

Silva and Lima, 1996); and others. There are a few studies that have investigated reusable packaging from various perspectives. Looking at consumers' behaviour and intentions, some studies have mentioned reuse during investigation into recycling and reduction as a comparison. Therefore, this section will start by looking at these studies through social behaviour then social demographics, and follow this by with social environmental responsibility and external incentives.

2.3.1 Social behaviours

The first step is to structure the social aspects by looking at social behaviours. The degree to which behaviour is seen environmentally is based on the behaviour's impact on the environment – if the behaviour motivates participation in environmental schemes (Barr *et al.*, 2001b; Mosler *et al.*, 2008; Schultz *et al.*, 1995). This section will not include the behaviour itself because it is too difficult a task to measure all behaviours and connect them with behavioural intention. This section will only highlight the main attributes that play an important role in influencing social behaviours.

2.3.2 Social demographics

In general, a community with a high level of education and environmental consciousness, availability of facilities and a high level of environmental campaigns leads to the achievement of highly environmentally friendly behaviours from consumers with more concern about waste tackling by different ways – recycling, reuse and reduction. For instance, some of the past research has shown that younger age (VanLiere and Dunlap, 1980), higher educational level (Samdahl and Robertson, 1989), and higher income status (Mohai, 1985) are positively related to concern for the environment. Moreover, other studies found that married participants were more likely to be concerned about the environment than single ones (Arcury *et al.*, 1987). Schwepker and Cornwell (1991) suggested that residents within smaller communities were less concerned about the environment than those in larger cities.

In a recent study, Edgerton *et al.* (2008) found that households where the residents were retired are more likely to participate in home composting (home composting is a new strategy that contributes to reduce the amount of biodegradable waste going to landfill),

and that families with young children are less likely to participate in home composting because their time is limited by looking after those children. It may be that the aspect that influences a household to participate in a home composting scheme may slightly differ from those that influence participation in packaging reuse scheme, but still most of the study proved that household age plays an important part in consumers' behaviour. The investigation into social demographic characteristics of environmental responsibility is very powerful in a descriptive sense and also in comparison with other aspects of social behaviour such as consumers' environmental responsibility aspects and consumers' incentives aspects. The research will consider these aspects (age, gender, education level, level income, personal norm, household size, and years of residence) on social demographics, as shown in Table 2-1, with relevant studies. As shown in Table 2-1, in some of the social demographic aspects considered during analysis, this chapter has considered the years of residence in the community, which will investigate the level of influence that years of residence in a community can have on packaging reuse.

Table 2-1: Social demographic variables

Social demographic	**Relevant studies**
Age	(VanLiere and Dunlap, 1980 ; Schultz *et al.*, 1995;Hornik *et al.*, 1995 ;Ebreo *et al.*, 1999 ; Barr *et al.*, 2001 ; Jenkins *et al.*, 2003 ; Edgerton *et al.*, 2008)
Gender	(Reschovsk and Stone, 1994 ; Schultz et al, 1995 ; Ebreo *et al.*, 1999 ; Barr *et al.*, 2001)
Education level	(Samdahl and Robertson, 1989 ; Hong *et al.*, 1993 ; Reschovsky and Stone, 1994 ; Schultz et al, 1995 ; Hornik *et al.*, 1995 ; Ebreo *et al.*, 1999 ; Jenkins *et al.*, 2003)
Level of income	(Richardson and Havlicek, 1978; Mohai, 1985; Hong *et al.*, 1993; Reschovsky and Stone, 1994; Hornik *et al.*, 1995; Jenkins *et al.*, 2003)
Personal norm	(Schwartz, 1977 ; Barr *et al.*, 2001 ; Edgerton *et al.*, 2008 ; Vicente and Reis, 2008)
Household size	(Richardson and Havlicek, 1978; Arcury *et al.*, 1987; Hong *et al.*, 1993; Reschovsk and Stone, 1994; Hornik *et al.*, 1995; Ebreo *et al.*, 1999; Barr *et al.*, 2001; Jenkins *et al.*, 2003; Edgerton *et al.*, 2008)
Years of residence	(Ebreo *et al.*, 1999)

2.3.3 Social environmental responsibility

Diffuse awareness around communities about environment issues and values is considerable in many studies. Schahn and Holzer (1990) identified two types of knowledge that affect recycling action. They are 'abstract' and 'concrete'. 'Abstract' means knowledge about the general environment while 'concrete' means knowledge

about provision of a service and awareness of how and when to use it. However, in this section the research will concentrate on the reasons behind the deterioration in social environmental responsibility.

An environment value means what the environment is worth. Values such as fairness, compassion, duty and human species survival are shaped by culture. If people were aware about the environmental values that conserve the environment, this would lead to a change in their attitudes and then behaviours towards packaging. Barr *et al.* (2001) demonstrated that researchers have debated those positive environmental values more likely to have a higher level of behaviour towards recycling. Stern and Oskmp (1987) proposed that environmental concern is the only the conservation behaviour that can be shared. Scott and Willits (1994) noted that concentrating on covering environmental problems in the media could contribute to teaching people the language of environmentalism. Baldassare and Katz (1992) mentioned that perception of the waste problem has an important effect on a person's behaviour. Barr *et al.* (2001b) reported that the most important thing behind strategies and campaigns set up to promote waste reduction is awareness of waste problems, which leads to people's increased willingness to alleviate the issues. Thus, if the consumer knows what to do and when to do it, behaviour would positively change as a result. Consumers with positive environmental values are more likely to engender a higher level of behaviour towards waste tackling. Schwartz's model (1977) of the theory of altruistic behaviour during investigating recycling behaviours found that low awareness of the consequences for the environment of not recycling leads to a low correlation between personal norms and personal behaviours. A lot of studies have focused on enhancing environmental values to increase pro-environmental behaviours. For example, in the United Kingdom, research has shown that environmental values receive lower scores than in other countries in Europe and the US (Skrentny, 1993). Grodzinska-Jurczak *et al.* (2003) emphasised that the presence of waste educational programmes and facilities' improvement led to increasing awareness and knowledge about waste issues. Therefore, the awareness of environment values is considered in a lot of research in order to increase social environment responsibility among communities.

In addition, community activities contribute to diffuse environmental responsibility, by influencing the attitudes of their members in order to reduce the amount of waste and explain the benefits and values behind that, and how this contributes to reduction in

environmental problems. For instance, the result of the study that investigated the attitudes towards recycling waste found that people are more willing to recycle if those around them do so (Barr *et al.*, 2001). Also, Larsen (1995) suggested that people who participate in environmentally responsible behaviours are likely to keep positive behaviours because of their contribution to the community and because it was expected from them as members of the community. Thus, increasing awareness about community activities among society would remove the doubt that waste treatment such as recycling or reuse does not add any value to the environment and about waste management systems, to which some people believe there is indifference, and which need added incentives for them to practise.

People with internal control who find that waste could lead to environmental problems have a positive attitude towards environmental consciousness. Henion (1976) stated that personal characteristics affect the environmental responsibility of consumers. Moreover, as demonstrated in Ebreo *et al.* (1999), there are many studies that add intrinsic incentives as a major role in facilitating conservation behaviours because they are derived from persuading people to participate in environmental activities. DeYoung (1986) illustrated that there are four categories of intrinsic incentives: frugality, self-sufficiency, participation and luxuries. The other part of intrinsic incentives is personal reasons to participate in environment schemes. If the consumer feels that behaviour will lead to a lot of benefits, such as economic ones, then this is the incentive to love the action; whereas, if people feel that behaviour is an inconvenience, then this will be a deterrent to do it (Vining and Ebreo, 1990). Therefore, looking at internal incentives for consumers to increase responsibility of environmental concern is needed. The prediction of pro-environmental behaviour is still a field with a high degree of uncertainty especially regarding packaging reuse, where there is no specific research looking at it separately, and there is a requirement for such research.

2.3.4 Social incentives

The second part of social influencing aspects is consumer incentives. Most methods that influence people come from motivation. Society changes their behaviour towards something; consumers' behaviour can be influenced if they find there are incentives encouraging them to do one thing and avoid another. In the environmental incentives, there are some aspects contributing to encourage consumers to think about the

environment, such as the belief that we can make a difference in reducing the amount of waste; this belief sometimes appears when there is a lack of facilities in the area and the consumer needs to do something to have a clean environment, and for their society. This type of feeling to do something to reduce the amount of waste is obtained if the consumers have a high environmental responsibility which leads to a change of attitudes. For example, Hopper and Nielsen (1991) found that the change of belief led to better attitudes in order to improve recycling behaviour. Another study was conducted by Barr *et al.* (2001), who concluded in their study of differences between household waste behaviours that one strong prediction about reuse behaviour is believing this makes a difference environmentally, and that those who have logistical problems and believe that reuse can make a difference are more motivated and more likely to reuse items. Belief that we can make a difference in developing waste management systems and the environment as well is a significant aspect in consumers' incentives, in which all the incentives could find a response from consumers who have this belief. Otherwise, it would not be valuable to encourage customers to think about the environment if they did not have any positive belief about it.

Conservation behaviour is the only attitude that can be found from environmental concern (Stern and Oskamp, 1987). Feeling responsibility towards protecting the environment would encourage pro-environmental behaviour. Although humans have the right to live in a clean environment, this does not drop eligibility for acting environmentally. There were some studies that mentioned this point with different terms, such as Barr *et al.* (2001), who demonstrated the importance of citizenship to improve waste reduction, and also Selman (1996), who used the term active citizenship, which refers to the importance of responsibilities among consumers. Moreover, the campaigns or programmes about services (such as recycling programme, reuse programme and reduction programme) that are used to reduce the amount of waste and contribute to a clean environment are also a good way in which to implant environmental responsibility. For example, in 20 US metropolitan areas, there were household surveys conducted by Jenkins *et al.* (2003) to estimate the intensity of recycling activities by running a drop-off and kerb recycling programme. The results have shown that this programme had a positive effect on the intensity of recycling activities. Thus, recognising the consumers' responsibilities to reduce the amount of waste is an essential aspect in environmental incentives.

Conversely, a personal incentive is the best inducement to persuade consumers about the environment and changing to better behaviours. As long as consumers find that it is useful (for example in such aspects as saving money, saving space, saving effort) to do things that tackle waste such as recycling, reusing and reducing, this would motivate them to do them. There are benefits from some waste-tackling facilities which are able to influence people's attitudes. An example is the heat supply service provided to residences from incineration of waste. This service influences people to dispose of their waste into an incinerator rather than landfill due to the benefit behind it (Ferreira da Silva and Lima, 1996). DeYoung (1986) proved that positive recycling behaviour was gained from being frugal during participating in activities. In any waste treatment activities, the customer's benefits aspect, which gives consumers some degree of satisfaction from any waste treatment activities, is likely to provide a positive feeling to maintain behaviour, and also the behaviour intentions have played a primary function which influences consumers to carry out any type of waste tackling (reuse, recycling, reduction) (Barr *et al.*, 2007).

However, the fact that experience of performing any waste treatment such as recycling, reusing, and reducing has a strong positive effect appeals to personal incentives, which logically leads to increasing the activity more and more. Some studies have shown that people with higher levels of experience are willing to perform any waste treatment measures. However, negative attitudes appeared towards unfamiliar facilities because people had no experience of them. Barr *et al.* (2007) found that people with experience of recycling represented only half of those willing to reuse and reduce the amount of waste. Thus, experiences about waste tackling create the intention to repeat the activities, which could be counted as an incentive.

Moreover, the ease of use of any of the waste treatment means how flexible and available it is. The amount of effort required for packaging reuse – such as having refilling stations for some product packaging by available facilities – is a predominant solution to the problem. This is because easy-to-use recycling bins have been accepted by some people, whereas those who find it difficult to use recycling bins may be opposed to recycling (Joos *et al.*, 1999). Vicente and Reis (2008) explained that ease of use in recycling means having better conditions at Eco-points, simplifying separation and deposits, having information on recycling, having support and receiving information about recycling via direct media. The ease of packaging reuse lies in the

fact of the condition of the packaging to be reused. For packaging, it is important to have information about how to reuse it and to receive information about it through direct media. As in recycling, providing people with access to a recycling bin at home leads to a rise in their willingness to recycle and think about the environment; whereas, people with no access to a recycling bin and who live in a bad environment often do not have any positive behaviours towards the environment. However, if the people with no access to recycling bins are aware about environmental values and issues, they will be more willing to minimise and reuse packaging in order to obtain a clean environment, as mentioned in some case studies (Barr *et al.*, 2001). Another study conducted in 324 communities in Massachusetts, USA aimed to estimate the ordinary least-squares coefficient of the determinants of recycling efforts. The results have shown that there was a 20.70% increase in the average recycling rate if the facilities of recycling are available to use which make the services easy to use (Callan and Janet, 1997).

Another incentive aspect that encourages a personal response towards the environment is being given support and moral incentives about waste tackling (recycling and reuse); for example, receiving money or having the collection fee reduced. For moral incentives, having friends, neighbours and family cooperation in packaging reuse programmes and public celebration of cooperation with any waste-tackling approach are both important. Vicente and Reis (2008) proposed important incentive aspects of moral incentives and support in order to increase people's propensity to recycle waste. Whether consumers participated or did not participate did not reduce the importance of this aspect. Therefore, the moral incentive with support given about waste tackling should be involved with other indicators that raise pro-environmental behaviour.

2.4 The importance of packaging design for reuse

Consumers' use of a product's packaging attributes has provided an intensive investigation in previous studies to determine the best packaging attributes by looking at consumers' choice. Packaging has an impact on manufacturing in terms of cost and performance, which could be harmful. The role of packaging in industry has gained importance due to logistics costs, developing packaging technologies and enhanced environmental regulations (Lockamy III, 1995). Thus, packaging design needs a comprehensive investigation across all functions (Azzi *et al.*, 2012). There are various dimensions where packaging design can influence packaging performance, such as

safety, marketing communication, logistics, ergonomics/geometry, sustainability and economic.

In terms of safety, packaging is to protect a product from damage or losing contents and to maintain human health. Preservation is the essential function of packaging. Sonneveld (2000) emphasised that packaging is a suitable way of integrating materials, and the value of packaging can emerge through developing the relationship between packaging manufacture and user requirements. Many studies highlight the importance of the safety function of packaging in terms of keeping contents safe – such as Kipp (2008), which investigated the transport vibration environment through a power spectral density approach through measurement, analysis and laboratory simulations of transport vibration and its effect on packaging contents. Also, there are many studies that emphasise the importance of packaging components. For instance, Ward *et al.* (2010) found that inappropriate packaging leads to misuse owing to its shape. They also highlighted the importance of laboratory tests before distributing the product packaging in the market in order to simulate the possible hazards during distribution (Bernad *et al.*, 2011). An example of a laboratory test is the Transport Vibration Laboratory Simulation (Kipp, 2008).

In a marketing communication dimension, packaging design raised the importance of social engineering attributes (the functions that influence people to perform actions) in terms of the social context and industries' initiatives in reducing environmental impacts (Holdway *et al.*, 2002). Packaging has fundamental functions in the market in order to attract consumers such as image, size, printing quality, brand name, colouring and shape. There is no doubt these functions can convey the qualities of the product and persuade consumers to favour purchasing the product. Orth and Malkewitz (2008) studied how modifying package design can achieve desired consumer responses related to consumer brand impressions. Most of the people were influenced at the point of sale (Solomon *et al.*, 2006). Thus, packaging becomes a critical factor for the consumer. Fluctuations in demographics and lifestyle drive the consumers' requirements, such as increased demand for intelligent packaging. Meroni (2000) evaluated the semantic and communicative aspects of packaging in food, finding that customers' requirements and the careful consideration of the environmental impact are part of this issue. Moreover, consumers who increase their demand for a product are often influenced by a moral view. Evidence can be found from Thφgersen's study (1999), which found how companies improve product selling when they design the product environmentally.

In logistics, packaging logistics is a new research concept. There are many studies that focus on the relationship between the concept of packaging and logistics, which shows how integrating packaging can lead to increased supply chain effectiveness and efficiency (Saghir, 2002). There are many benefits of integrated packaging design for logistics. For instance, García-Arca and Prado-Prado (2006) stated that the improvement of transport space from innovative packaging design led to reduction of cost and environmental impact. Azzi *et al.* (2012) found that the attention of most studies was on logistic activities; however, no study mentioned how packaging design influences logistics such as the need for repackaging to fit on the warehouse shelf.

From an ergonomics dimension, ergonomic aspects drive a range of organisational, industrial and consumer activities. In industry, equipment, manual assembly lines, and bending and lifting packaging in warehouses could cause injuries to workers. For consumers, packaging shape, weight and materials all affect people using the products. Thus, addressing ergonomics will contribute to reducing worker injuries in terms of weight limits, variations in size, opening packaging, emptying and handling packaging. For example, Lee and Lye (2003) proposed assessing the efficiency of packaging design in various aspects in order to identify inefficient packaging aspects and improve them. Ergonomic aspects have an important relation to accessibility of packaging content for different categories of users (Langley *et al.*, 2011). Yoxall *et al.* (2007) emphasised the need for ergonomics in packaging design to ensure that customers have easy access, and the use of different sizes and shapes, which could be helpful for different users' requirements.

From a sustainability dimension, sustainability in packaging consists of three elements: natural environment, society and economic performance. Azzi *et al.* (2012) mentioned that there is less research into a sustainable approach towards packaging design on social and environmental concerns due to the effort that is made over the economic aspects. Verghese and Lewis (2007) found that packaging sustainability has continuously improved due to the creation of new materials exclusively for the packaging process, new packaging design and configurations which create changes in packaging. These changes can bring great opportunities to develop sustainable packaging in terms of the environment, and economic and social aspects. Packaging aspects have strong environmental impact throughout the packaging life cycle. Packaging systems consume resources and energy, create waste and generate emissions.

Thus, there is a lot of research to show the importance of recycling, reuse and to introduce policies and regulations for disposal return for companies in order to distribute the waste management cost and transfer responsibility onto product manufacturers.

Moreover, economic sustainability of packaging is essential, making profits on packaging the main aim in industry. A lot of studies have investigated packaging costs. However, better packaging design is a way to obtain cost efficiencies related to the cost of the manufacturing process, supply chain and environmental cost, and covering the hidden costs related to ergonomic performance and lost sales (Mollenkopf *et al.*, 2005). Social sustainability is a critical factor when focusing on social requirements such as health care, hygiene and safety. Any development in order to achieve cost reduction and logistics requires a great effort. Vernuccio *et al.* (2010) outlined the important attributes that packaging addresses for social sustainability such as eco-compatibility, information about packaging, societal orientation, safety and social solidarity.
After reviewing the importance of changing packaging design for safety, marketing communication, logistics, ergonomics and sustainability, it is now time to review the packaging design in relation to one-way packaging and also reusable packaging such as refillable packaging.

2.4.1 Studies of packaging attributes

This section discusses previous studies that investigated packaging attributes with an integrated approach from primary and secondary packaging perspectives. Due to the lack of research on identifying reusable packaging attributes, this section reviews comprehensive models that described packaging attributes from previous studies. There is much research that considers packaging design from different perspectives. Lockamy III (1995) highlighted three main areas: finance systems, resource systems and customer performance systems. Olsmats and Dominic (2003) integrated a theoretical framework for a packaging scorecard. Rundh (2005) designed a framework link function of packaging with marketing. Simms and Trott (2010) constructed a framework that related the distribution chain to the stakeholders' perspectives. Svanes *et al.* (2010) proposed a framework which has several indicators: environmental sustainability, distribution cost, product production, market acceptance and user-friendliness. Williams *et al.* (2008) mentioned that there are around 24 quality attributes of a product which

help guide good design or manufacture. However, Azzi *et al.* (2012) conducted a systemic approach on qualitative and quantitative literature on packaging design in order to roadmap further packaging design studies. This systematic approach demonstrated the strength of different packaging systems and discovered the interaction between one factor and another and how this changes the system (Mollenkopf *et al.*, 2005). Azzi *et al.* (2012) addressed some failures in previous studies to address packaging design related to social sustainability and ergonomics. The study, on the conceptual framework of packaging design, consists of five main aspects of safety, ergonomics, sustainability, logistics, and marketing and communication. These five aspects contribute to understanding and analysing efficient packaging design. The Azzi *et al.* model identified 42 social, economic and environmental factors. These factors concentrated on primary packaging design and assisted packaging designers to understand the important factors which lead to successful and innovative packaging solutions.

The work presented here considered the Azzi *et al.* model for three reasons. The first states that some of the attributes of general packaging can be implemented for reusable packaging. The second reason why the Azzi *et al.* model has been selected is inclusion, which included all packaging life cycle attributes. The third reason states that it is sustainable, considering the sustainability of packaging attributes in the whole life cycle, which reflects economic, social and environment benefits.

Refillable packaging is another possible solution to reduce the amount of waste produced. Recently, a project conducted between Loughborough University and the Boots Company investigated the potential benefits a refillable packaging system for a body wash can offer customers and the environment (Lofthouse *et al.*, 2009). The main aim of the project was to improve the sustainability performance of packaging through two objectives. First, the project sought to understand the variables that impact on existing refillable packaging for consumers and businesses. Second, the project team expected the finding would help develop a refillable packaging system from consumers' and business perspectives. The project consists of three main stages: literature review, questionnaire and workshop. In the early stages, the project recognised 16 types of refillable packaging through market analysis and literature review. In order to understand the positive and negative attributes of refillable packaging, some questions were raised in a questionnaire distributed to volunteers who participated in the activities.

Some 89 questionnaires were answered and participants ranged in age from 21 to 71. Then, a workshop was conducted to investigate business drivers and barriers. The data from the workshop were analysed by a clustering methodology (Lofthouse *et al.*, 2009).

The project used different types of packaging such as self-dispense (the consumers take a reusable packaging back to store and then refill it with the same product), original packaging swapped for a new product (e.g. the consumers return empty packaging and take a new product), deposit system (e.g. the consumers return empty packaging to the manufacturer for a financial incentive), top-up card (e.g. the consumers pay for a delivery service refill by using a payment card), dispensed concentrate (e.g. the consumers can obtain hot drinks and fizzy drinks from a Soda Stream machine), dispensed product (e.g. the consumers buy a dispenser then refill the packaging a number of time) and concentrate mixed in original packaging (e.g. the consumers buy a product which has good packaging quality, such as fabric softener bottles, to refill the packaging). The key findings regarding the attributes of a refillable packaging system from the consumers' perspective are summarised in Table 2-2. The results show that lightweight packaging and ease of opening the dispenser encourage them to refill the body wash product. Quality and durability are important. The project also found that price incentive is one of the important factors together with the quality of packaging to be refilled. The findings also highlighted that, as long as there is a good reason behind the refill approach, consumers will not mind participating in the activity (Lofthouse *et al.*, 2009).

Moreover, the project investigated the incentives and barriers associated with refillable packaging. For drivers, the project found that environment benefits from refillable packaging converge with reducing distribution effort; less energy and materials are used that would otherwise end up in landfill. Also, the project found cost savings for manufacturers (reducing the amount of materials), saving on waste management system (reducing the amount of waste during collection), saving on transportation, saving for customers, and, finally, an increase in sales. In the market, refillable packaging also brought some opportunities for market completions. The project discovered that space, addition of cost, health and safety, additional waste and new business models are barriers to refillable packaging. In Lofthouse *et al.* (2009), the study determined some reusable packaging attributes especially refilling from a social point of view as there was a lack of research trying to find reusable packaging attributes. The research

presented here is going to use these attributes for further investigation to test if they are capable of implementation for various types of reusable packaging.

Table 2-2: Positive Attributes and Negative Attributes of Refillable Packaging Systems (Lofthouse *et al.*, 2009)

Positive Attributes	Negative Attributes
Good product quality	Expensive refills in giveaway parent pack
Convenient delivery	Inconvenience / requiring additional planning
Good value	Take up more space
Less packaging and or product waste	Hassle of maintenance
Easy to use	Increased waste
Clean and hygienic	Poor product quality
Takes us less space	Bad delivery
Light to transport	Bad quality packaging
No mess	'Fiddly' to refill
Cheap	Concerns over how long refill will be available
Quick to use/refill	Incompatibility between systems
Incentives / rewards for use	
Suitability for purpose	

The refillable packaging attributes did not include the packaging contents because the participants did not worry if the packaging had been used, or was new, wet or dry. As long as they are able to clean the packaging, they are encouraged to refill it; they will clean the packaging and then re-use it (Lofthouse *et al.*, 2009). As shown in the participants' statement in Table 2-2, they are looking for packaging that is easy to clean and refill.

There is only one study that has analysed reusable packaging attributes in relation to waste. Langley *et al.* (2011) conducted a real case study in the UK to determine how different packaging can encourage and discourage the consumer in relation to options such as reusing, recycling and composting. The study focused on transition of packaging and observed consumers' behaviour and found a relationship between shopping for goods and disposal of waste packaging. The study used different kinds of methods in order to find out how different packaging design attributes can affect consumer behaviour in the store and at home. The study used a questionnaire, a digital diary and bin raids to obtain quick and easy results. The study was focused in the South Yorkshire region of the UK around Sheffield. The participants gave information about the research and they were selected from known contacts. There was no repetition of participants during the three methods. Ten households participated in bin raid tests; after requests, appointments were arranged and approval for photographs was given. Sheets of plastic were laid out for the bin contents to be analysed on, and all waste bins in the house were gathered in order to observe them. The digital diary tests were conducted in

five households. The author observed the cupboard products at the beginning and end of the day for five continuous days. The questionnaire was conducted with 200 questions which consisted of some product images under various dimensions for attributes of packaging. There was a choice for respondents to tick such as general waste bin, recycling, reuse and compost. The questionnaire was conducted at three different supermarkets. The study found that there are good intentions amongst people to tackle waste but due to unavoidable pressures in everyday life they did not convert this intention into environmental behaviours.

Also, the study found that clear labelling on packaging is necessary with more information about how to deal with waste. Moreover, the study found that clearer and more consistent information on packaging helps to reduce poor control and management of the product. Easier to clean packaging would reduce unwashed items going to landfills. Thus, the study found that waste that should be reused or composted, because of packaging attributes, did not go into the bin or recycling in the consumer's mind. All packaging attributes discovered in this study are outlined in Table 2-3. The study identified the main packaging attributes that consumers preferred from their dealings with waste such as reusing, recycling and composting. The research is going to use these attributes for further investigation because the Langley *et al.* study did not determine which attributes have a relationship with reuse of packaging.

Table 2-3: Langley Framework of Attributes of Packaging (2011)

Materials	**Geometry**	**Other**
Glass	Refill ability with other product	Recycling
Metal	Clean ability	Instructions
Plastic	Re-seal ability	Endurance
Cardboard		Branding relating to quality and value

2.5 The environmental impact of designing new packaging to be reuse

In the context of DfE, the other concept of sustainable packaging appears to help the manufacturers design their packaging for the environment. Sustainable packaging is a concept about the idea of how to develop the packaging environmentally. The aim of sustainable packaging is to give valuable roles to packaging in social and economic systems, while also acknowledging the need to meet ambitious environmental goals (Sonneveld *et al.*, 2005). According to Sonneveld *et al.* (2005), packaging plays a significant role in sustainable development through the life cycle of products, such as

distribution, marketing and safe use for the customer. They argued that customers' behaviour and marketing segmentation are examples of drivers for new packaging concepts and contrary to the principle of sustainable development. Sustainable packaging manufacturers need to develop customers' expectations about packaging and have aspirations that customers will increase their desire for environmentally friendly packaging (Sonneveld and Lewis, 2004). Therefore, there are many companies that want to provide more sustainable products and seek to develop environmental initiatives during packaging design to be more sustainable in how they operate, but there are some barriers to implementing sustainable packaging, as summarised in the Sonneveld *et al.* (2005) study as follows:

- Complexity of product marketing systems.
- Required capital investment associated with new technologies.
- Inability to identify and adopt step change technologies that support packaging sustainability.
- Maintaining commercial advantage.
- Lack of a clear understanding of what constitutes sustainable packaging.

Lenox *et al.* (2000) found that technical competency centred on a range of information relevant to environmental design and coordinated with product design teams would help to diffuse the environmental initiatives. Hence, the Sustainable Packaging Alliance (SPA) was established in 2002 amongst Victoria University, RMIT University and Birubi Innovation Ltd to address these barriers. The main aims of SPA are to provide businesses with the knowledge about sustainable packaging, and the tools and skills to make informed packaging sustainability decisions that generate commercial and sustainability benefits (Sustainable Packaging Alliance, 2005). There are four principles of SPA's sustainable packaging definition, which are effective, efficient, cyclic and safe, from a stakeholder survey which aims to explore the current connotation of sustainability for companies in the packaging supply chain and some of its key external stakeholders (Sonneveld *et al.*, 2005; Sustainable Packaging Alliance, 2010).

After SPA identified the principles of sustainable packaging in theory, it was time to translate that into practice to make the concepts tangible amongst global stakeholders and also to interpret the definition into more specific targets, performance indicators, guidelines and tools (Sonneveld *et al.*, 2005). From a business point of view, sustainable packaging is also becoming increasingly more vital in the marketplace. The marketing

functions of sustainable packaging that develop packaging to be sustainable can contribute to saving resources and reducing the environmental load. Sustainable packaging is also important in the supply chain. Therefore, scholars and companies began to seek immediate directions in which to implement sustainable development principles in product packaging development. There are many studies seeking to investigate sustainable packaging in order to find the drivers and barriers which could face industries and to identify the main aspects that lead to achieving sustainable development. Two types of studies are used to investigate the environmental effects that appear when packaging is altered. The first type is concentrating on the packaging itself, without interaction with the food system such as agriculture, food industry, food storing, preparation and food waste. These studies always focus on the amount and the type of material with respect to resource use, packaging production, transports and waste handling. For instance, De Monte *et al.* (2005) compared environmental impacts associated with alternative packaging systems on the supply of coffee in terms of changing the materials and the process used. Zabaniotou and Kassidi (2003) also made a comparison study between egg carton packaging designed from polystyrene and recycled paper in terms of mass and energy consumption. The second type of studies is concentrating on the entire food-packaging system, which is highly complex. For example, identifying food losses is an important environmental issue in the food-packaging system (William *et al.*, 2008).

There are many environmental aspects that may change with new packaging designs. The environmental impact from the resource during the production process of the package can be from materials, energy use, fossil fuel consumption, oil and gas use and electrical use. Many previous researchers have investigated the effectiveness of changing packaging design on the resources, such as Zabaniotou and Kassidi (2003) and Cederberg and Mattsson (2000). Also, the environmental impact of packaging can occur when it is transported due to change in the shape and weight of packaging which could occupy spaces as shown in some studies (Jahre and Hatteland, 2004). Finally, the environmental impact of packaging could come from waste handling of the packaging, as shown in previous studies (Björklund and Finnveden, 2005; Eide, 2002).

However, other studies have investigated the environmental impact of developing packaging to be sustainable packaging through a comparison tool with normal packaging. For instance, Svanes *et al.* (2010, as cited in Detzel and Krüger, 2006)

conducted a comparison study between PLA packaging and packaging made of petroleum-based materials such as Polypropylene. The study included all the life cycle of packaging from cradle to grave in order to obtain a good picture of the products' environmental performance. The results have demonstrated that the PLA material gives top-load strength to the packaging and this solves quality issues. Also, Detzel and Krüger (2006) made another study about Polyethylene Terephthalate (PET) packaging and found potential benefit for recycled packaging. Another study calculated the direct environmental impacts of packaging, and evaluated the effect of packaging reduction through LCA (Bovea *et al.*, 2006). These studies do not assess the new packaging materials' effect on the environment and economy but concentrate on the aesthetics of packaging.

However, in reusable packaging, Ross and Evans (2003) conducted a study which concentrated on examining the environmental impact of recycle/reuse strategies for a plastic-based packaging system through LCA. An Australian case study was selected, which was Email Ltd, which produces approximately 350,000 refrigerators in Orange, in inland New South Wales. This company was concerned that its current packaging was not sufficient to implement a recycling and reuse strategy due to its weakness, which caused a lot of packaging damage and that precluded reuse. The company was using Expanded Polystyrene (EPS) plus a tight heat-shrunk transparent Polyethylene bag (PE) packaging. The company desired to use a new material that meets recycling/reuse strategies. Then, the company proposed new packaging, which can employ recycling and reuse activities, through binding a layer of High-Impact Polystyrene (HIPS) instead of EPS and encasing it with PE heat-shrink wrap. The results showed that the proposed packaging made a significant effect on the reduction of energy consumption and greenhouse gas emissions due to its ability to be recyclable/reusable. Also, the oil consumption of the proposed packaging is about one-third less compared with the existing packaging (Ross and Evans, 2003).

Moreover, there are many firms seeking to integrate their packaging to be sustainable packaging by designing reusable packaging. With regard to materials, the companies have focused on two aspects. They prefer to use low weight of packaging per unit of product and avoid some types of material that cause harm to the environment, such as Polyvinyl Chloride (PVC). For instance, the Coca-Cola Enterprise has pledged to reduce the carbon footprint of its packaging by 15% by 2020 through using less material

for each product, using more recycled and plant-based materials and making sure that Coca-Cola packs are recyclable (Coca-Cola Enterprise, 2012). The main reason behind setting this goal is that 50% of the carbon emissions across the chain come from packaging materials. Therefore, the Coca-Cola Enterprise is seeking to reduce its carbon footprint through introducing lightweight cans and providing a number of recycling zones. The Coca-Cola Enterprise is also working with the Waste and Resources Action Programme and Recycling of Used Plastics on a number of different projects in order to reach their targets of reducing packaging weight and providing recycling zones. The chief executive officer of Coca-Cola Enterprise indicated that, although there is an economic crisis, the company's goals demonstrate the progress it is making, and it is working to exceed all the expectation from retailers, customers and consumers.

Other companies have also utilised different attributes such as: packaging design & materials type, environmental communication, post-consumer recycling, hygiene/easy to disinfect, meeting consumer need, less waste, refill ability with other contents, holding content safety, easy to open/reclose, packaging characteristics, safe materials, packaging mass & shape, portability, quality & value of packaging and convenience of use. For example, in 2010, Kentucky Fried Chicken (KFC) introduced a reusable side container. This reusable packaging is made of polypropylene and uses a "ventless vent technology", which allows moisture to escape without requiring a hole in the lid. This reusable packaging is safe to wash and microwave (Kentucky Fried Chicken, 2010). Susan Miles (Kentucky Fried Chicken, 2010), engineering manager at KFC, said that, *"Through research, we found that consumers prefer reusable containers because it gives them control of how the item is reused or disposed of after purchase, our research also showed that 60 percentage of consumers keep a reusable container for at least six weeks"*. The results regarding KFC reusable packaging (Kentucky Fried Chicken, 2010) are that it:

- Reduces the packaging form by 62% and total plastic use by 17%.
- Replaces single-use, non-recyclable EPS with a reusable and more widely recycled resin.
- Represents the highest value in stored energy when incinerated as an end-of-life solid waste component and part of a waste-to-energy programme, at 38 million BTUs per ton of material.
- Requires 25% less energy to produce.
- Generates half the amount of greenhouse gases.

The KFC reusable packaging has good attributes; however, it still needs to have further investigation to assess the environmental impact of this new design and its effect on economic performance. Also, the Pizza Hut Enterprise has introduced a new pizza box design that allows the box to be broken down into plates and a smaller box for leftovers. It is eco-friendly, highly functional, and easy to store and dispose of. This new packaging design was developed under partnership with Central American Packaging Manufacturer SigmaQ. This packaging uses Ecovention's patented Green Box technology. The inventor of this idea is Scott Wiener. He believes that designing reusable packaging has the power to solve waste conflicts and make the world a better place to live (Kelley, 2013). The result of introducing the Pizza Hut green box was that more than 9,000 tons of paperboard were saved annually, which adds up to 46 million square feet of corrugated board (Yum, 2012). Another company, PUMA, had faced problems regarding the amount of waste paper and cardboard, which are their main input materials, at offices, warehouses and stores. PUMA aims to use recycled paper and cardboard. The recycling rate in 2010 was 32%, which slightly increased in 2011 to 37%; however, PUMA also introduced a new packaging design in 2010 called 'Clever Little Bag' and a 'Half-size Clever Apparel Pack' in 2012 (PUMA, 2012). It is a red, reusable shoe bag used to package its footwear. As a result of this new design, PUMA reduced the amount of cardboard consumption and amount of polyethylene it used. The Clever Little Bag has decreased cardboard usage by 5,400 tons in comparison with conventional shoeboxes. The Clever Apparel Pack has also reduced polyethylene waste by 40 tons (PUMA, 2012). These savings are over 17 times more than PUMA's annual paper consumption (PUMA, 2012). PUMA's new slogan is 'Make and Do Things Sustainably'.

However, in their annual reports neither PUMA nor Pizza Hut mentioned the environmental impact from the new packaging designs. Hence, based on the industries' initiatives in packaging, the need of further investigation on the environmental impact directly associated with new packaging design is required, especially for reusable packaging. This investigation can answer a lot of questions raised by manufacturers and can expect environmental results on designing reusable packaging, which may or may not add great value and positive aspects for the environment and economy.

2.5.1 Indicators for testing environmental impacts

Any product consists of two main processes: background and foreground systems, as stated in Sonesson and Berlin's (2003) study about analysing the environmental impact of supply chains for dairy products. The actual handling of dairy products is the foreground system. This consists of track transport (moving the raw material inside firms), car and van transport (transfer products to retails and households), retail and households. The background system contains the necessary inflows such as packaging material, water and energy in various forms, and also to take care of its residues (Sonesson and Berlin, 2003). The results from these systems are emissions (solid waste, water, air) and resource (consumption energy) wastes.

Jasch (2000) has described an organisation's operation based on ISO 14031, which consists of physical facilities and equipment. This organisation's operation includes a list of inputs and outputs such as materials, energy and services supporting the operation as inputs and products, wastes and emissions as outputs. Therefore, it is important to distinguish between the inputs and the outputs of environmental interventions in any organisation's operation, as stated by Heijungs *et al.* (1992a). Hence, there are many indicators that firms use to evaluate their environmental performance based on their environmental policy, objectives and targets. In the literature, many environmental indicators have been considered in many studies in order to investigate the environmental impact of an organisation or new product/packaging.

In this section, the research is looking at the extant literature that has examined environmental impact in organisations and products/packaging in order to identify the most indicators used to investigate the environmental impact of reusable packaging. Monitoring performance with indicators is a common management tool that is applied in many studies such as measuring financial performance, operational efficiency, quality, and customer satisfaction (Tsoulfas and Pappis, 2008). However, the environmental and sustainability performances have become an important task amongst companies, which most companies are seeking to achieve (Lamberton, 2000). The environmental indicators can be identified through a lot of previous research that identified environment impact indicators from various perspectives. Some of these studies measured some indicators that are suitable for specific areas such as small and medium enterprises (Rao *et al.*, 2006), construction activities (Shen *et al.*, 2005), food supply

chain (Mintcheva, 2005), thermo power plants (Montanari, 2004), railway vehicles (Vandermeulen, 2003) and oil refineries (Bevilacqua and Braglia, 2002). Tyteca (1996) analysed the nature of various plants in firms and causes of environmental inefficiencies through defining several measurement lists of environmental impacts. Sonesson and Berlin (2003) assessed the environmental impact of various supply chains for dairy products in Sweden. Olsmats and Dominic (2003) used some environmental indicators to investigate business performance, such as volume and weight efficiency, reduced use of resources, minimal use of hazardous substance, and minimal amount of waste and packaging.

Moreover, other studies have investigated the effect of products/packaging on the environment by some indicators. For example, Ross and Evans (2003) assessed packaging performance over the life of existing and proposing packaging. They found that the proposed packaging can yield significant environmental benefits from the indicators that are based on availability data; however, Ross and Evans intended to examine more environmental indicators but the lack of data obstructed further investigation. Svanes *et al.* (2010) analysed emissions and resources waste to examine the environmental impact of new design packaging. They measured greenhouse gas emissions and energy use through six different sub-indicators that were related to environmental and resource impacts, and also measured degree of filling – which is a very essential indicator to test the level of transport efficiency for the supply chain as a lorry has limited space, and for the product itself as the product should fit the packaging snugly. It is measured by the percentage of total volume of the pallet that is filled up with the secondary packaging, percentage of total volume of primary packaging in secondary packaging and percentage of total volume of product in primary packaging. Williams and Wikström (2011) studied the relationship of packaging design and food losses and its effect to reduce the environmental impact through investigating five different types of food packaging. The list of environmental impact indicators that most researchers have used to assess the environmental performance or production/packaging is presented in Table 2-4 and the idea of listing these indicators is to identify all environmental interventions which eventually represent the environmental impact from products/packaging and determine the explicit commitment for developing environmental performance. As Heijungs (1992b) found, all environment issues can be traced through a product's production. The impacts from treatment of waste are not

accounted as indicators due to the functionality of reusable packaging which aims to delay throwing the packaging into landfill.

Table 2-4: Environmental impact indicators in the literature review

Dimensions	Indicators	Description	References
Recourses	Primary energy	Primary energy demand (Ton); Proportion of clean primary energy (%)	(Wang *et al.*, 2013), (Tyteca, 1996), (Sonesson and Berlin, 2003)
	Net energy	Terminal energy consumption (Ton)	(Xie and Hayase, 2007), (Global Reporting Initiative, 2008), (Wang *et al.*, 2013), (Figge *et al.*, 2002), (Sonesson and Berlin, 2003), (Svanes *et al.*, 2010), (Williams and Wikström, 2011)
	Fossil fuel consumption	Number of units of energy consumed during production/use of product (Kg)	(Wang *et al.*, 2013), (Figge *et al.*, 2002), (Ross and Evans, 2003)
	Oil and gas use	Proportion of coal in energy consumptions (Q × BPA/kg for oil)(Q × BPA/m^3 for gas)	(Xie and Hayase, 2007), (Global Reporting Initiative, 2008), (Wang *et al.*, 2013), (Michaelis, 1998)
	Electrical use	Quantity of energy used per year or per unit of product; quantity of energy used per service or customer; quantity of each type of energy used; quantity of energy generated with by-products or process streams; quantity of energy units saved due to energy conservation programmes (Q × BPA/KWh electricity)	(Xie and Hayase, 2007), (Global Reporting Initiative, 2008), (Wang *et al.*, 2013), (Michaelis, 1998), (Energy Information Administration, 2001), (Jasch, 2000)
	Raw material use	Quantity of materials used per unit of product; quantity of processed, recycled or reused materials; quantity of packaging materials discarded or reused per unit of product; quantity of auxiliary materials recycled or reused; quantity of raw materials reused in the production process; quantity of water per unit of product; quantity of water reused; quantity of hazardous materials used in the production process (Kg)	(Jasch, 2000), (Tyteca, 1996), (Figge *et al.*, 2002), (Xie and Hayase, 2007), (Global Reporting Initiative, 2008), (Svanes *et al.*, 2010)
Emissions	Global warming/Clim	The term ‘climate change’ indicates that the possible consequences of global warming concern	(Jasch, 2000), (Brentrup *et al.*, 2004), (Sonesson and Berlin,

	ate change	more elements of the global climate than only the temperature. It is measured through the quantity of Co_2, N_2O and CH_4 per year; quantity of Co_2, N_2O and CH_4 per unit of product (Kg)	2003), (Williams and Wikström, 2011)
	Eutrophication	Eutrophication can be defined as an undesired increase in biomass production in aquatic and terrestrial environments. It is measured by NOx, NH_3 , NH_4 , NO_3 , NO_3–N , P, P_2O_5 and PO_4 (Kg)	(Jasch, 2000), (Brentrup *et al.*, 2004), (Sonesson and Berlin, 2003), (Williams and Wikström, 2011)
	Acidification	Air emissions of sulphur dioxide SO_2 , nitrogen oxides NOx and ammonia NH_3 (Kg)	(Jasch, 2000), (Brentrup *et al.*, 2004), (Sonesson and Berlin, 2003), (Williams and Wikström, 2011)
	Photochemical oxidants	Production of tropospheric ozone and other oxidants such as O_3, H_2O_2, nitrogen and hydrocarbons (Kg)	(Jasch, 2000), (Brentrup *et al.*, 2004), (Ross and Evans, 2003), (Sonesson and Berlin, 2003)
	Greenhouse gas emissions	Quantity of specific emissions per year; quantity of specific emissions per unit of product (Kg)	(Jasch, 2000), (Ross and Evans, 2003), (Tyteca, 1996), (Svanes *et al.*, 2010)
	Air pollution	Quantity of emission that may be released by manufacture such as SO_2, NOx, CO and NH_3 (Kg)	(Jasch, 2000), (Brentrup *et al.*, 2004), (Sonesson and Berlin, 2003)
	CO_2 emissions	Quantity of CO_2 of vehicles in fleet; quantity of CO_2 released to air from manufacture (Kg)	(Jasch, 2000)
Solid waste	Effluents	Quantity of effluents per year or per unit of product (Kg)	(Global Reporting Initiative, 2008), (Figge *et al.*,2002), (Jasch, 2000)
	Toxic wastes	Quantity of waste per year or per unit of product; total waste for disposal; quantity of material sent to landfill per unit of product (Kg)	(Global Reporting Initiative, 2008), (Figge *et al.*,2002), (Jasch, 2000), (Tyteca, 1996), (Olsmats and Dominic, 2003), (Svanes *et al.*, 2010)
	Hazardous wastes	Quantity of hazardous waste produced per year (Kg)	(Jasch, 2000)

Water waste	Water consumption of dyeing processes; quantity of specific material discharged per year; quantity of specific material discharged to water per unit of product; quantity of waste energy released to water. It is measured through Biochemical Oxygen Demand (BOD) value, which is the amount of oxygen that bacteria in water will consume to breakdown waste (m^3) and Chemical Oxygen Demand (COD) which test the amount of organic compounds in water in the level of biologically active organic matter.	(Xie and Hayase, 2007), (Figge *et al.*,2002), (Jasch, 2000)

Moreover, there are some models and tools that are used to assess the environmental impact of packaging. Hence, SPA has developed the Packaging Impact Evaluation Tool (PIQET©) in order to provide credible indications of environmental performance to support industries to accomplish environmental requirements and to link environmental impact with packaging functional performance (Sustainable Packaging Alliance, 2006). PIQET© measures global warming/climate change, cumulative energy demand, photochemical oxidation, water use, solid waste and land use to determine environmental impacts of packaging (Sustainable Packaging Alliance, 2006). LCA tool is also used to evaluate sustainable packaging performance. LCA is the leading assessment method with a complete life cycle scope. The main advantage of LCA is the emphasis on function, which means that a product's effectiveness to perform a certain task is taken into consideration (Svanes *et al.*, 2010). The packaging scorecard evaluation model has also a wider scope than PIQET; this takes into account practical aspects and parts of the distribution chain (Olsmats and Dominic, 2002). Also, the Wal-Mart Company has developed and implemented a Scorecard Method for sustainable packaging evaluation (Wal-Mart, n.d.). Moreover, Svanes *et al.* (2010) produced a comprehensive tool which takes the whole distribution chain and life cycle into consideration and evaluates the packaging system as a whole and gives quantitative output that can be used to optimise packaging. They invented a comprehensive tool through a comparison between the different methodological approaches, based on different characteristics such as environmental resource, economy, social elements, packaging and product system, whole life cycle and others (Svanes *et al.*, 2010). These tools and models used various environmental impact indicators, as shown in Table 2-5.

Table 2-5: Comparison of some packaging design tools (Source: Svanes *et al.*, 2010)

Methodology Characterisation	**Sustainable Packaging Design**	**Olsmats & Dominic's (2002) model**	**Wal-Mart Packaging**	**PIQET**
Environmental and resource indicators	Waste GHG emissions Energy use	Volume and weight efficiency, reduced use of resources, minimal use of hazardous substance, minimal amount of waste and packaging	GHG emissions, product/package ratio, cube utilisation, transportation efficiency, recycled content, recovery value, use of renewable energy	Global warming / climate change, cumulative energy demand, photochemical oxidation, water use, solid waste and land use.

In addition, the international standard for Environmental Performance Evaluation (EPE), ISO 14031, has also measured environmental performance through different indicators (International Standard Organization, 1999). EPE is an ongoing process to assess an organisation's current environmental performance and identify areas for improvement and provide useful information. EPE has indicators which are used to explain the quantity of environmental data comprehensively and concisely (Jasch, 2000). There are two general categories of indicators that EPE standard uses: environmental performance indicators and environmental condition indicators. Environmental performance indicators only describe the measurement undertaken by the management to influence the environmental performance, such as percentage of employees with environmental training, number of environmentally friendly suppliers, number of infringements against emissions, etc. However, environmental condition indicators describe the direct impacts on the environment and provide the condition of the environment within an organisation.

Moreover, EU Eco-Management and Audit Scheme (EMAS) regulation is also a management tool used by companies and organisations to evaluate and improve their environmental performance. EMAS aims to improve environmental and financial performance and to communicate the environmental achievements to the stakeholders and society (European Commission, 2014b). EMAS has set minimum requirements to control a company's compliance with the environment where the indications concentrate on waste and resources in order to assess the environmental performance.

In sustainability, there are a lot of models that include environmental indicators as one dimension in order to assess the firms or countries' sustainability. For instance, the "Pressure-State-Response" environmental policy model aims to shift environmental decision-making to use more firmly analytic foundations through the Environmental

Sustainability Index (ESI). The ESI is a composite index tracking a diverse set of socioeconomic, environmental, and institutional indicators that characterise and influence environmental sustainability at the national scale (The Environmental Performance Measurement Project, 2014). The ESI is focused on a broader measurement of environmental conditions, such as all pollution levels, natural resource endowments and environmental management efforts (Liu, 2007). The ESI integrated 76 variables into 21 indicators and the final score was computed by weighted summation. The ESI mixed the waste and resources indices into various categories. Firstly, the environmental system category contains environmental indicators such as air quality, land, water quality and quantity. Secondly, reduction of environmental stresses category concentrates on the reduction of waste and resources such as reduction of air pollution, reducing waste and consumption pressures, natural resource, etc. Thirdly, the ESI assesses social indicators and, finally, it measures some of the global issues such as greenhouse gas emission. The majority of ESI indicators look at the environmental impact from waste and resources perspectives and also sometimes from societies' and institutions' points of view.

Moreover, Phillis and Andriantiatsaholiniaina (2001) and Andriantiatsaholiniaina *et al.* (2004) developed a model called Sustainability Assessment by Fuzzy Evaluation (SAFE). This model measures the overall sustainability of countries by combining the basic indicators of environmental integrity, economic efficiency, and social welfare. The model consists of two dimensions: ecological sustainability, which includes indicators about land, water, air and biodiversity; and human sustainability, which includes political aspects, economic welfare, health and education. The SAFE model separates the sub-compounds into three categories: pressure, status and response. Pressure measures the human activities employed, status measures the overall sub-compounds, and response summarises the environmental, economic and social actions. This model has undergone three main revisions from 2001 until 2011 and has received a lot of improvement, as discussed in Grigoroudis *et al.* (2014)'s study about SAFE 2013. Also, Grigoroudis *et al.* (2014) summarised all the indicators with the source of data and the data thresholds. All the detail about the SAFE model can be found at the website http://www.sustainability.tuc.gr. The main advantages of SAFE are to define overall sustainability for a region or country and to identify those indicators that affect sustainability the most (Kouloumpis *et al.*, 2008). The main ecological indicators that the SAFE model measures concentrate on the effect on the land, water and air from

waste such as solid waste generated, nuclear waste, urban households with garbage collection (recycling), BOD emission, phosphorous concentration, greenhouse emission, atmospheric concentration, etc. However, with regard to resources, the SAFE model did not test all the energy resources but only looked at clean energy production, such as renewable energy and fossil fuel use.

Most of these studies measured these dimensions with the set of indicators that were determined by stakeholders and subject matter experts from the business scope, which drive many of the decisions about what measures to include when evaluating environmental impact. The use of environmental impact indicators faces some problems that are difficult to overcome. The problems start at the very beginning, when a company only uses indicators that are not modelled for its activities. It is easy to define an environmental impact indicator, which would account for the quantity of a pollutant that is produced during a process, but the difficult part is to define the boundaries of the system within which impacts are effected (Tsoulfas and Pappis, 2008). According to Jasch (2000), environmental impact indicators may have different purposes such as comparison of environmental impact over time, highlighting of optimisation potentials, derivation and pursuit of environmental target, identification of market chances and cost reduction potentials, evaluation of environmental impact among firms (benchmarking), communication tool for environmental reports, feedback instrument for information and motivation of the workforce, and technical support for environmental management systems. Some indicators may be completely applicable to some businesses but not to others. This may be due to fundamental differences between the value and environmental aspects of a company's different operations and products/packaging. Also, some of the indicators simply are not significant issues for particular areas or some indicators measure different parameters for different areas. Also, according to Jasch (2000), the principle for derivation of environmental impact indicators is that the indicators should be comparable, target-oriented, balanced, continuous, frequent and comprehensible. Also, Andriantiatsaholiniaina *et al.* (2004) found during investigating sustainable indicators that there is no unique path and accordingly selecting suitable indicators and strategies is the best way to make efficient decisions. A well-established environmental impact indicator for measuring reusable packaging is needed as it is a new area of investigation in packaging.

2.5.2 Recent industries in reusable packaging and the gap in the research

The concept of green productivity comes from the ability of any development strategy to be sustainable (Hwa, 2001); in other words, the improvement of the products leading to reduced environmental impact, increased profitability and quality of the products. Designing environmentally friendly products should be one of the top priorities for the governments and manufacturers and can reduce the raw materials used and develop business competitiveness (Chen and Sheu, 2009). In the past, companies attempted to utilise reusable packaging in the market place, but they had little success, and so did not continue with these experiments. For instance, in Canada, the average number of refillable beer bottles reduced from 47% in 1985 to 5% in 1997 due to the industrial use of non-refillable bottles (Rowe and Platt, 2002; Grimes-Casey *et al.*, 2007). In Western Europe, there is a high prevalence of refillable packaging used for beverage containers. However, the average overall number of refillable bottles has slowly fallen across Europe. In 1979, around 81% of the beer bottles sold in Europe were refillable, whereas in 1997 this was only 60%. The main reason behind this is the European beer market has favoured one-way packaging (Rowe and Platt, 2002). In the United States, reusable packaging for soft drinks declined from 100% in 1947 to 1% in 2000 due to increased use of metal cans and plastic (PET) bottles (Rowe and Platt, 2002).

Nowadays, some companies are making attempts to design reusable packaging for the marketplace, such as Pizza Hut, PUMA, KFC, etc., but this needs to be increased in order for reusable packaging to dominate the market and for reuse to be diffused as a solution to decrease waste. An example of how this could be achieved is the Starbucks reusable cup. As stated in the Starbucks annual report (Starbucks, 2013), there is a need to increase the number of customers who reuse their personal reusable cup. As shown in Table 2-6, in 2013, an increasing number of beverages were served in reusable cups (49.9 million beverages) compared with 2012, which was 35.8 million beverages. The annual report has shown that there is a need for more improvement in order to achieve a 5% increase in the number of users of reusable cups.

Table 2-6: The Starbucks reusable cups' usage (Starbucks, 2013)

Year	Beverages served	Percentage of Reusable cups served
2012	35.8 million	1.5 %
2013	46.9 million	1.8 %

2.6 Summary

To sum up this chapter on the environmental impact of poor waste management systems, the waste recovery rate is another important element which needs increased focus and needs to be taken into account during the design of new waste management systems. There are a lot of approaches regarding recovery of waste, such as recycling materials, landfill, incineration, etc.; however, after an economic recession some studies found that some countries could not afford the high cost which occurs during the recovery process, and that it is not easy to assess social structural influences and organising influences. Reliance on disposable items rather than dependence on reuse is another issue which increases the amount of waste generation. The reuse approach should be a suitable approach as it does not require more money to apply it, and its aim is to save resources and reduce the amount of waste going to landfill. This does not mean that the reuse approach will replace other approaches such as recycling or recovery approaches, but it can work alongside them. There are a few reusable packaging designs in the market nowadays and more research is required into how to enhance reuse amongst industries and societies. As far as this research extends, it is going to investigate the method to increase the production and availability of reusable packaging in the market and the possible techniques to encourage people to reuse packaging rather than throw it in the bin. This is achievable through designing a conceptual framework, which will be developed in the next chapter.

CHAPTER 3: Research methodology

3.1 Introduction

This chapter describes the structure of the research and how it was conducted in order to achieve its aim and objectives. The main aim of the research is to propose an integrated method to reduce environmental impact from waste packaging and to increase knowledge on the best way to enhance reusable packaging. The research presented here seeks to enhance the practice of reusable packaging amongst societies and industries. The development of the conceptual framework requires that relevant knowledge be extracted from customers and experts who have experiences in the field of packaging and environmental impact. However, the process of obtaining knowledge is complex, lengthy and fraught with difficulties. This chapter will concentrate on the various types of research strategies applied in this thesis. It will deliver the whole issue of research design such as research conceptual framework, research perspectives, research types, research methods, sampling selection, data collection and analysis techniques.

3.2 Conceptual framework

The theoretical framework has added significant value to this thesis in order to identify the scope of the topic; however, the conceptual framework is directing the research to concentrate on a specific area to find out the latest innovation. In light of the theories cited in the review of related literature and studies, the conceptual framework aims to highlight the importance of enhancing the reuse of packaging amongst societies and industries. Moreover, this thesis will present the objectives that deliver the main goal of enhancing the reuse of packaging and will also set up the hypotheses which are going to be tested through the thesis. Finally, this thesis is going to set up the research scope which contributes to concentration on the research aims and objectives.

A conceptual framework is a structure of the research concept and some studies call it the research paradigm. It describes the relationship between the specific variables which are identified in the theoretical framework. It elaborates the waste management issues of waste in relation to reusable packaging. The conceptual framework embodies the research into a specific direction on the subject of environmental impact reduction and development of a waste management system. It outlines the input, process and output of

the whole investigation. It summarises and integrates knowledge into research, provides explanations for causal linkages, and contributes to the generation of hypotheses.

3.2.1 Identification of the conceptual framework

The social, economic and environmental points of view are key functions for the development of a waste management system and environmental impact reduction. The research recognises that there is weak knowledge about the importance of reuse and there is no evidence to show how to enhance the reuse of packaging. The lack of knowledge comes from unknown variable elements that lead to increasing reliance on reuse as the option for tackling waste. There is reliance on simple approaches such as landfill, incineration, dumpsites, etc. and expensive approaches such as recycling, which is unaffordable for some developing countries. Selection of the appropriate approach that involves all sectors is a complex task and needs an intensive evaluation process which considers the requirements of government, environment regulations and economic level. Nevertheless, there is a lot of evidence that waste disposal can be improved by introducing a new approach, but some approaches have not succeeded. For instance, in 2002, the European Environmental Agency added another approach, namely biodegradable waste, which includes an integrating approach to developing strategies, and focuses on quality but the European Commission was regulated in May 2010 to minimise the biodegradable wastes through certain ratios because of the production of methane (Crowe *et al.*, 2002; European Commission, 2010).

The ideas that have been used to reuse packaging are from customers' habits regarding some types of product where they keep the product packaging and use it for other purposes. Also, postponing discarding packaging has a powerful effect which leads to reducing the overall amount of waste. The theory behind this idea is that it is influential in reducing environmental impact and takes a burden from waste management systems' shoulders. In addition, the reuse approach needs deep thought regarding the innovative design, which helps to reuse the packaging. After that, the reuse approach needs careful consideration about the environmental impact of the packaging reuse design. Finally, educating consumers about the importance of considering the green environment in everyday life is essential by encouraging concentration on the reuse of packaging. Hence, it is important to introduce the reuse of packaging in terms of social, economic and environmental points of view in order to obtain successful results with regard to

environmental and human health factors. Therefore, the conceptual framework of this research is going to examine enhancing the reuse of packaging against reduction of environmental impact.

3.2.2 Explanation of the variables within the conceptual framework

As shown in Figure 3-1, it is essential that social, manufacturing process and environmental impact points of view are the key drivers of this conceptual framework in order to enhance reusable packaging amongst societies and industries. Also, these three drivers are consistent where each function leads to the other until reaching the main goal of enhancing reusable packaging. It is a significant task to understand that customers' behaviour and attitudes towards reusable packaging are the key elements that lead consumers to reuse their packaging. This can be achieved by identifying consumers' attitudes, norms, awareness about the environment, incentives and condition of packaging, to enhance reusable packaging in consumers' priorities. For instance, if the information on the label told customers that they can use the packaging to store its contents or reuse the packaging for a different purpose, it may affect consumer behaviour (Williams *et al.,* 2008). With regard to consumers' awareness, according to the Tulasa project (Nepal, 2008), which dealt with developing a waste management system and as a result educating the community, people's attitude towards disposing waste has changed. As a consequence, from a social perspective, it encourages the community to think environmentally and practice reuse more. There are a lot of ways to extract consumers' requirements, as is shown in the evidence in the literature review. Aarnio and Hämäläinen (2008) have strongly suggested that the industry could put into action decision-supporting tools such as customer surveys, which help to identify demand. Early identification of consumer demands builds a competitive atmosphere among companies to develop product quality (Olsmats, 2002). For instance, in New Mexico, USA, Holy Cross Hospital established a new reusable packaging programme in 2012 to decrease the number of food containers as part of an internal green campaign. They found that staff used a lot of food containers every day. Therefore, they provided a lunch container that staff could buy and then reuse. As a result, reusable packaging contributed benefits to the hospital and implanted the importance of conserving the environment amongst the staff (Leach, 2012). Further, advertising to change consumers' habits plays an important role. Brewers Retail has successfully used advertising to implant the idea of reusable beer bottles via refilling in consumers' minds (Rowe and

Platt, 2002). Hence, it is important to understand the customers' behaviour and attitudes towards reusable packaging, which can influence the packaging's function. Therefore, it is important to investigate the customers' orientation, which can influence them to practise reuse packaging in order to enhance reuse packaging. This phase contributes to enhance packaging reuse amongst society.

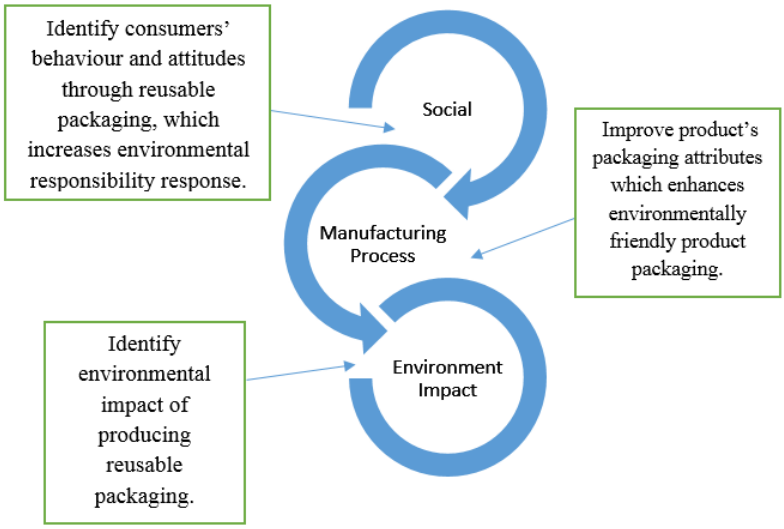

Figure 3-1: Conceptual Framework of the thesis

The second phase is to develop a manufacturing process which also plays an essential role in enhancing the reuse of packaging. Developing design guidelines is an important task in the preparation and design of the packaging to be reused. It is useful and beneficial to industrial designers. As shown in the literature review, efficient product design is a first priority that any waste management system seeks to find in industries (Marsh and Bugusu, 2007). The literature review also showed that there were a number of problems facing customers while using specific packaging owing to poor internal design. For instance, Johansson (2002) discussed the average amount of products such as food left in some packaging because of the poor internal design. In addition, Löfgren (2004) reported that packaging's functions of protecting the contents and facilitating storage and transport are not sufficient from the customer's perspective because of weak internal design. Williams and Wikström (2011) commentated that the important issue of the product being designed in a proper way in order to decrease food losses, and all of the fundamental functions of product design, such as protection, convenience and communication, should be addressed. These considerations help the consumer by

different attributes such as packaging being easy to reseal to avoid biological deterioration, easy to empty completely to avoid throwing away any of the contents, provided in suitable sizes to avoid leftovers, etc. These functions, or attributes, are starting to be important to consumers (Löfgren and Witell, 2005). As customers are dissatisfied about the packaging design's ability to hold the contents safely, they are not encouraged to reuse the packaging, as it has not met its first functionality. By achieving these changing design guidelines from an industry point of view and in internal design from a social point of view, these developments result in high credibility among communities and high sustainable production among industries. Industries can produce high-quality products that are able to be reused several times. In the final stage, this leads to reduction in environmental impact and on waste management load. Therefore, it is an essential task to look at packaging development from an industry point of view by enhancing new innovative designs to combine functions and information, and then think how to make the packaging reusable.

Moreover, there is much research that emphasises how behaviour control can influence consumers' participation in the way waste is tackled. For instance, in recycling activities, there are many studies investigating the availability of recycling bins which found that ease and availability of use led to acceptance behaviours amongst people, whereas people with no access to recycling bins are not engaged to recycle (Ajzen and Fishbein, 1975; Callan and Janet, 1997; Joos *et al.*, 1999; Barr *et al.*, 2001b). However, much of the previous literature does not really address the dominating factors of behaviour control in reuse. It is important to address behaviour control on product packaging to encourage reuse behaviour. Thus, in order to divert waste from landfill, it is necessary to do everything possible to design innovative product packaging, which stops product packaging from being perceived as waste in the consumer's mind. The consumer needs to be convinced of the reuse of product packaging as having more 'worth'. Without control of consumer behaviour, one-way packaging would dominate the market. It is important to conduct research into product packaging design functions and features to revive re-usability and rebuild packaging infrastructure. A higher perceived value by consumers is likely to divert more waste packaging away from landfill.

One unintended effect described in the literature was a concern that developing the functional use of the product to be reused might result in an increase in using the

materials, which will increase product cost, energy used, fossil fuel consumption, etc. If companies are planning to produce reusable packaging, their concern will raise issues about how producing reusable packaging is going to affect the environment. This point leads to investigate the third phase in the conceptual framework. A lot of manufacturers design their packaging with consideration for the environment due to the environmental compliance to reduce amount of waste, to which they must adhere. Hence, many studies have investigated the environmental impact of changing packaging design. Some of these studies only investigated packaging without interaction with the food system (De Monte *et al.*, 2005; Zabaniotou and Kassidi, 2003; Cederberg and Mattsson, 2000; Jahre and Hatteland, 2004). Other studies concentrated on the food packaging system and its environmental impact (William *et al.*, 2008).

Moreover, some studies have investigated developing packaging to be sustainable and have made comparison with normal packaging in terms of materials, oil consumption and Lifecycle Assessment (LCA) (Svanes *et al.*, 2010; Detzel and Krüger, 2006; Bovea et al., 2006; Ross and Evans, 2003). In addition, in industry, some companies have designed reusable packaging and investigated some of the environmental impacts of reusable packaging attributes (Coca-Cola Enterprise, 2012; Kentucky Fried Chicken, 2010; Yum, 2012; PUMA, 2012). As noticed in the literature, there are no comprehensive studies that show the environmental impact of all the reusable packaging attributes in terms of amount of resources used, water, emissions and solid waste. A third phase is going to investigate the environmental impact of reusable packaging through its attributes. The second and third phases contribute to enhance reuse packaging amongst industries. At the end of construction of a conceptual framework, the conceptual framework will be embedded in important reusable packaging in terms of social and industrial aspects.

3.2.3 Testing of the conceptual framework

The conceptual framework will be tested in order to: (i) explore if it is capable of encouraging communities to increase their environmental responsibility; (ii) explore whether it equips practical packaging with a greater potential to be reusable; and (iii) explore if it provides a high degree of methodological support to recognise how to reduce environmental impact from producing reusable packaging. This thesis will test the conceptual framework in a real case study in order to validate if it can contribute

positively to solve some industry issues to enhance reusable packaging, help other companies to set up planning to implement reusable packaging in the production line, and contribute to reduction of the environmental impact of packaging issues. If the discussion after analysing the results points positively towards environmental benefits, then the conceptual framework will have made a clear contribution.

3.3 Research structure

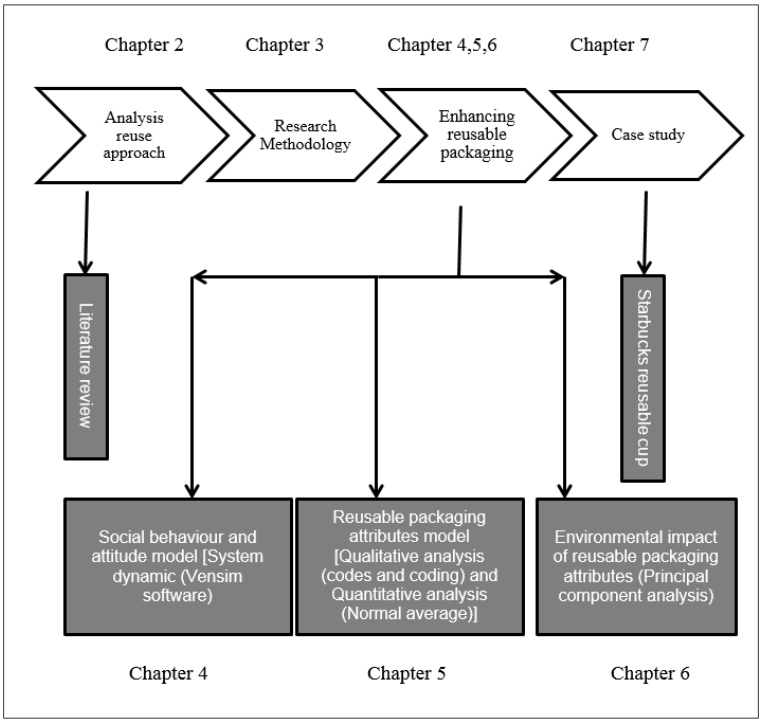

Figure 3-2: The research structure

As shown in Figure 3-2, the research structure provides an illustrative view of the purpose of this research upon which the research methodology will be concentrated.

3.3.1 Analysis reuse approach in terms of benefits, behaviour attention, design attributes and environmental impact (Chapter 2)

There are many benefits of a reuse approach for society, the economy and the environment. In Chapter 2, many studies have been reviewed in social behaviour, packaging attributes and environmental impact. This can develop the conceptual framework, which could contribute to reducing waste if there is concentration on the reuse approach.

3.3.2 Social behaviour and attitudes towards reusable packaging methodology (Chapter 4)

This chapter draws on a number of different activities carried out during several stages, as shown in Figure 3-3. The literature review identified factors which influence people's behaviour towards packaging throughout the previous studies investigating consumers' behaviour towards recycling, composting waste and reduction of waste. The chapter limited the search to academic journals on consumers' packaging behaviours, mainly identifying the main drivers that lead to pro-environmental behaviour, such as recycling and composting waste. Articles on the packaging recycling process, composting process and degraded process and their technologies were excluded from the review.

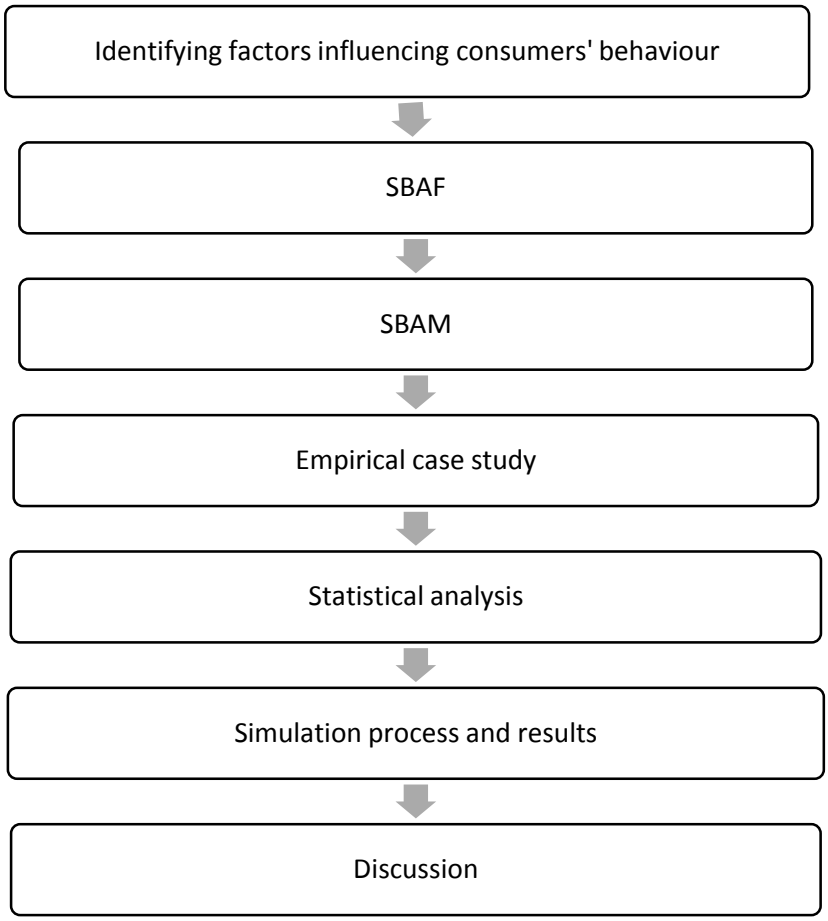

Figure 3-3: Methodology for considering social behaviours towards the reuse of packaging

From the literature review, a range of attitudes and behaviours were revealed to construct a Social Behaviour Aspect Framework (SBAF). The SBAF based on Cognitive Behaviour Theory (CBT) as a basis, with the Theory Of Planning Behaviour (TOPB). After that, the research selects a quantitative SD method that offers a means by which to highlight the dynamics and interrelationships among the different social

aspects in reusing packaging. The chapter will generate a Social Behaviour Aspect Model (SBAM) throughout two main stages in SD: causal loop and stock-flow diagram. Then, an empirical case study for Jeddah, Saudi Arabia will be conducted through a questionnaire. The variables are measured in the questionnaire on a 5-point Likert scale [0:5]. Some studies in SD have various scale units. For example, a model for hospital waste management (Chaerul *et al.*, 2008) measured health risks on a scale [0:2]; and in a waste management model (Dyson and Chang, 2005), the study used a scale [0:5] for measuring behaviours and regulation, which was influenced by information about treatment prices and percentage of recycling in collected waste. The research focuses on citizens with all levels of income and education. The research does not stick to specific gender and age but is available to all ages and for both genders. The data related to the main research were mainly collected through a survey distributed amongst societies in Jeddah city. Following that, statistical analysis will be carried out to explain the data. Then, the chapter will simulate the SBAM using data from empirical research in Jeddah, Saudi Arabia and present the results. This will be followed by analysis and discussion before moving to suggestions and conclusions with suggestions for further research into consumers' attitudes towards reusable packaging.

3.3.3 Discovering reusable packaging attributes methodology (Chapter 5)

As intimated in the introduction, this chapter draws on a number of different activities carried out during several stages, as shown in Figure 3-4.

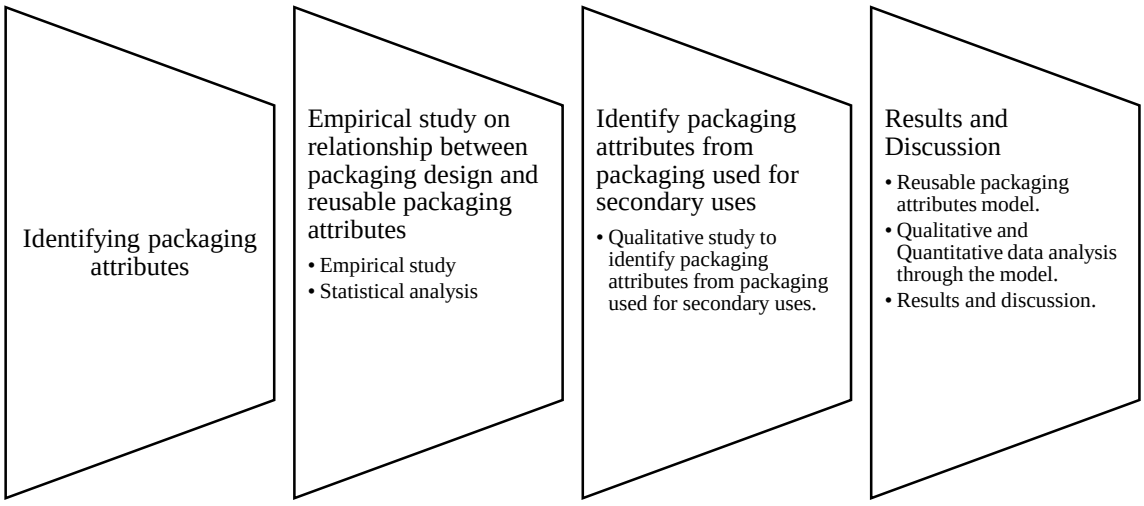

Figure 3-4: Exploring reusable packaging attributes' methodology with its methods

From the literature review, this chapter can define clear boundaries which is a range of attributes for reusable packaging were revealed in various dimensions, such as logistics, geometry, marketing communication and sustainability. An empirical study on the relationship between packaging design and reusable packaging attributes was completed, testing the reusable packaging attributes through experts' experiences in designing packaging. A wide range of findings emerged from the empirical study, using experts' experiences in the field of packaging design and packaging optimisation. Following that, there was a statistical analysis of the data. Also, from the literature review, the research found that there were no studies identifying packaging attributes for packaging used for secondary uses. Qualitative research was conducted using questionnaires (for identifying packaging attributes for secondary uses) to identify packaging attributes from packaging used for secondary uses. Qualitative data was analysed using 'codes and coding'. Then, after analysing the data, the reusable packaging attributes checklist was generated. Following the analysis and discussion section, this section interprets the 'BS En 13429:2004 reuse of packaging' standard in the reusable packaging attributes checklist, which facilitates understanding requirements and procedures of packaging attributes. Finally, the chapter provides conclusions and suggestions for further research in the field.

3.3.4 Investigating the environmental impact of reusable packaging attributes methodology (Chapter 6)

This chapter is designed through various steps. First of all, this chapter designed environmental impact indices that assess reusable packaging attributes through some of the extant studies on environmental impact, international standards, and some sustainable models. Then, this chapter seeks to discover the relationship between environmental impact indices and reusable packaging attributes. The aim of this chapter is to discover the reusable packaging in the production stage through appropriate methods that use experts' experiences. Owing to the importance of determining the extent to which reusable packaging attributes affect environmental impact through the indices, factor analysis with PCA can discover which are the main important composite indicators affecting the environment from various groups of reusable packaging attributes from multi-index factors. This is a kind of weight-determined method. Factor analysis with PCA is one method used to evaluate the relationship between various factors. This chapter will explain the factor analysis with PCA method in detail in the method section. After that, the chapter is going to conduct a survey based on experts'

experiences in environmental impact and packaging before moving to the results and discussion section. Finally, the chapter will end with the result of environmental impact of reusable packaging attributes with some further recommendations after the conclusions.

3.3.5 Case study phase (Chapter 7)

In Chapter 7, in order to validate the framework, the research will use Starbucks reusable cup as a case study. Starbucks needs to increase the demand for its reusable cup to meet its goal in 2015 of reducing waste packaging, energy used, water used, materials used, and emissions. The result of conducting a case study into Starbucks will be some suggestions based on how to enhance customers' behaviour and attitude towards the Starbucks reusable cup by applying SBAM. Also, in this phase some recommendations about the Starbucks reusable cup attributes will be provided by implementing the reusable packaging attributes checklist. The case study will also show how the reusable cup led to a reduction in environment impact.

3.4 Descriptions and ideas linked to research design

3.4.1 Research methodology

The research methodology is the essential part in any research. It is a way to systematically solve the research problem and explain how the research has been conducted scientifically (Kothari, 2004). The research methodology has to describe the research techniques and how the research is relevant, what it means, why it is used, and also explains the assumptions of underlying various techniques.

3.4.2 Research techniques

Research technique constitutes a part of the research methodology. It is a method and tool which is concerned with the collection of data, and statistical techniques that identify the relationship between the data and what is unknown and evaluate the accuracy of the results obtained. Research technique shows the research decisions about

how to develop certain indices and the reason behind using this method compared with other(s) to solve the research problems. In this research, there is a difference between data collection and methods. Data collection technique is an approach to data collection from which the information can be extracted and methods are a process that can use the data and analyse them to find the results.

3.4.3 Research design

Research design can be described as the research plan to formulate the research problem. It should be as efficient as possible to yield the information. Research design depends on the research purpose. In this thesis, exploratory research was used as it has a flexible research design to consider various aspects of the problem, according to Kothari (2004). Several methods have been used in many studies such as case studies, questionnaire, interviews, survey, experiments, experts' opinion, observation and photography. Some of these methods are suitable to answer a specific research problem and others are not. There is not one specific design that can fit all the research purposes. Many studies combine more than one method to answer their research questions. In this research, there are some parts that use only one method and other parts that combine two methods. Therefore, there is no one rule that researchers can follow to select a specific method. It is dependent on each set of circumstances. The following sections show sampling selection and the methodology of data collection and analysis.

3.5 Sampling selection, data collection and analysis

There are various methods of sampling selection depending on the type of research process. Kothari (2004) listed the important sampling designs such as deliberate sampling, random sampling, systematic sampling, stratified sampling, quota sampling, cluster sampling, multi-stage sampling and sequential sampling. The logic of statistical sampling is an abstract which starts from an idea of research object and distribution, in which material is put together according to certain criteria such as demographic, social situation, etc. (Flick, 1998). An alternative method of sampling is the strategy of complete collection. The sampling is limited to various criteria such as a specific age, region, a limited period and a particular material.

In this thesis, Chapter 4 will perceive and evaluate the customers' behaviour and intention towards reusable packaging and Chapter 5 will identify the reusable packaging attributes from customers' perspective. Several dimensions of these samples have been defined such as all samples have the same types of developers and likelihood, a group of students as well as non-students, employees and non-employees, and the samples do not focus on specific gender, age or country (for more details about customer sample see Chapters 4 and 5). The sample size in this part of the thesis was validated through statistical analysis. Snowball sampling and random sampling methods were used. The snowball sampling concept of 'who-knows-who' asks participants who else should be participating (Malhotra and Birks 2006). Snowball sampling was used to escalate the potential number of contacts. Random sampling gives the chance for every member of a population to participate in the study in order to distinguish between random sample and population of interest.

Moreover, the experienced professionals involved in the packaging design and environmental impact were chosen to be the sample population as they would be aware of the importance of developing packaging and its influence on the environment. Owing to their ability to compare and define to what extent reusable packaging attributes are important to produce reusable packaging in various ways and also to what extent the environmental impact of reusable packaging attributes would reduce the environmental dilemma about packaging issues, they were the most suitable participants in this research. The experts consulted in this thesis have the adequate education, skills and experiences from the field (for more information about the experts see Chapters 5 and 6). The sample size in this part of the thesis was three experts in Chapter 5 and nine experts in Chapter 6. This sample size was considered acceptable for this particular study as Saaty (2001) found that a small sampling size of less than 10 experts is acceptable and necessary because the professionals should share a consistent belief. The convenience sampling method was used in this part of the thesis. Convenience sampling focuses on the data that are selected by those who provide it such as information from experts. Convenience sampling is used in this thesis due to the researcher's knowledge of the experts in the area of packaging design and environmental impact from their published papers. The reason behind implementing the test cases in the next chapters is to provide a unique opportunity that will enhance the validity of data collected.

This section describes the process of the data collection used in the thesis. The choice of data collection comes from the inadequacy of the data to deal with real-life problems. There are different types of data collection: primary data collection, which involves collecting new data, and secondary data collection, which concentrates on the existing data from previous studies. Primary data collection is the only method that has been used in this thesis because there is no secondary data available from previous studies as it is a new area of research.

Such an approach can entail qualitative and quantitative methods to gain and examine the data. Each method is based on the information used to study a phenomenon. The qualitative research method can be construed as information such as words, sentences and narratives whereas the quantitative research method can be construed as information such as numbers and figures (Bryman and Bell, 2011). Blumberg *et al.* (2011) stated that there is no such predominance of qualitative and quantitative methods. Flick (1998) stated that the qualitative method cannot be independent of the research process but is embedded in it. Also, the quantitative research method can explore new phenomena. Quantitative and qualitative studies represent different research strategies in terms of the role of theory. Therefore, it is obvious that the research problem can be investigated qualitatively and quantitatively. Owing to the scarcity of the research conducted in this area, this research needs to use an approach involving the use of multiple methods to understand the research problem.

In this thesis through conducting an intensive literature review about the customers' behaviour and attitude in Chapter 4, various type of factors were identified and the quantitative method was needed to collect and analyse the data. An SD method was utilised through customers' experiences in reusing packaging within their lifetime. In Chapter 5, various packaging attributes were identified in the literature review, which needed a quantitative method to use experts' opinion through utilising the normal average method. In Chapter 6, owing to the need to discover the relationship of a number of environmental factors to the reusable packaging attributes, the quantitative PCA method, which utilises experts' judgments, was used. Full explanations and discussions for SD, normal average and PCA methods are explained in Chapters 4, 5 and 6 respectively. However, in Chapter 5, there is the need to use a qualitative method to explore the attributes that persuade consumers to reuse packaging. This is achievable through the codes and coding method, which is a common approach that defines

meaning from participants' words. The results of the qualitative method assist in the design of a reusable packaging attributes checklist. The collected data in the previous section must be further analysed prior to being used in the other stage of the research. In order to ensure that the gathered data are reliable and consistent, an additional test was carried out in each technical chapter in the thesis. Qudrat-Ullah and Seong test and validation of the structure and behaviour of the SD model were carried out on the data collected (for more detail about the validation processes see Chapters 4 and 5).

3.6 Summary

This chapter has explained the various research designs in an effort to lay down the basis for the research. It has presented the main philosophical perspective behind the research methodologies. Research techniques, research design, sampling section, data collection and data analysis have been explained in detail with relation to the type of research techniques, type of sampling and the process of data collection used. The next chapter will provide the first part of the framework to discover the relationship between customers' behaviour and intentions, and reusable packaging practices in order to identify the main aspects that lead to increasing the number of reusable packaging practitioners.

CHAPTER 4: A system dynamics analysis for enhancing social behaviours regarding the reuse of packaging

4.1 Introduction

Fundamental values and active concerns for the environment amongst society, such as reduction of the waste stream, is a necessary topic of research. Reuse of packaging alleviates public concerns over the increasing rate of resource consumption and waste production by decreasing the quantity of waste going into landfills and reducing the production rate of waste. The reuse of packaging has influenced each step of the waste life cycle. Reuse of packaging leads to shopping reduction so that people will need to shop less if they can reuse the previous packaging. If consumers purchase reusable products, this reuse of previous waste products or packaging can affect people's behaviour by leading to a reduction in shopping (DeYoung *et al.*, 1993).

This chapter discusses the reuse of packaging from a social perspective in order to understand the barriers and motivation that contribute to enhancing reuse of packaging amongst societies. The existing research into waste treatment has been reviewed and compared with the actual reuse of packaging that is practised. This chapter aims to discover people's attitudes towards reuse of packaging and proposes an SD model that focuses on social aspects that increase pro-environmental behaviour as the motivational conduit through which other aspects converge to affect behaviour.

The chapter builds a conceptual framework through the different social attitudes and actions that lead to increased packaging reuse behaviour. The conceptual framework studies the effectiveness of improving social aspects on packaging reuse behaviour and investigates the aspects that increase packaging reuse behaviour among consumers. The novelty of this chapter lies in two aspects: firstly, integrating CBT with TOPB in order to identify the aspects that are relevant to enhancing reuse of packaging from a social perspective; and, secondly, the employment of an SD approach, which is not currently used to present social aspects on any methods of tackling waste.

4.2 Social behaviour aspect framework

In order to address social aspects, it is essential to conceptualise a set of aspects and provide a suitable framework. The conceptual framework of social aspects on waste is formulated from a review of the literature and it identifies different aspects at different levels, i.e., social demographic, socio-environmental responsibility, social and environmental incentives, altruism and intrinsic motivation, environmental threats, logistics, perceived behaviour control (PBC), TOPB and CBT.

PBC demonstrates the consumers' beliefs in terms of the difficulty and controllability of performing a specific behaviour (Ajzen, 1985, 1991). PBC consists of two premises. The first states that an individual's external conditions influence their ability to adopt certain behaviour. The second premise states that an individual's ability to do the behaviour depends on perceived performance or convenience of the behaviour and the specific knowledge about the behavioural tasks that require participation (Valle *et al.*, 2005). PBC predicts the behaviour directly and indirectly through intentions. TOPB is a foundation in the theory of reasoned action, which consists of two principles. The first is that individuals can act rationally. It means that an individual should know how to act and have available information before acting. Once these have been delivered, the individual is expected to behave accordingly. The second principle is that intentions to act are determined by attitude towards the behaviour and subjective norms (Ajzen and Fishbein, 1975). TOPB allows relationships among five relevant predictors identified in previous research in the field of recycling: (a) the attitude towards the act; (b) subjective norms; (c) PBC; (d) specific knowledge and communication; and (e) perceived convenience of the provided service (Valle *et al.*, 2005). This theory is concentrated on specific attitudes towards the behaviour rather than general attitudes. This theory does not take into account the influence of social-demographic attributes.

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 (Jesse and Wright, 2006; Wright *et al.*, 2003). 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 shift thinking processes, participants can think more clearly about the choices they make and the behaviours in which they engage. CBT focuses on participants in any activities to understand their weak points as well as offering techniques that enable participants to learn to make changes in their behaviour.

The methods for CBT were outlined by Beck in the 1960s and then elaborated in a treatment manual (Beck, 1964). The application of CBT has occurred in many fields such as mental health, e.g. depression, anxiety disorders and eating disorders (Wright *et al.*, 2003; Gaffan *et al.*, 1995). CBT is applied in education and training, organisational psychology, management consultancy, and sports psychology. In solid waste management systems, there is not any research considering CBT when investigating consumers' behaviour regarding waste treatments; however, this research considers CBT based on four premises. The first states that CBT is instructive. When non-practitioners understand how to reuse packaging rationally, then they have confidence that they can undertake packaging reuse. The second premise states that CBT creates long-term results. The third states that CBT is cross-cultural, which means that the practitioner, in order to reinforce reuse of packaging behaviour, constructs his goal based on his orientations. The last CBT premise is that CBT is structured, enabling it to identify any defects in reuse behaviour. The conceptual framework is illustrated in Figure 4-1. It is developed from TOPB, which includes influence from relatives and friends' norms, general environmental concerns, perceived knowledge, personal and social values, perceived convenience and better conditions of product packaging. All the aspects extracted from the literature review can be integrated into one framework that shows the importance of concentrating on the social aspects. In addition, the framework includes the three steps in CBT theory: cognitive (people informed), behaviour intention (people aware) and behaviour change.

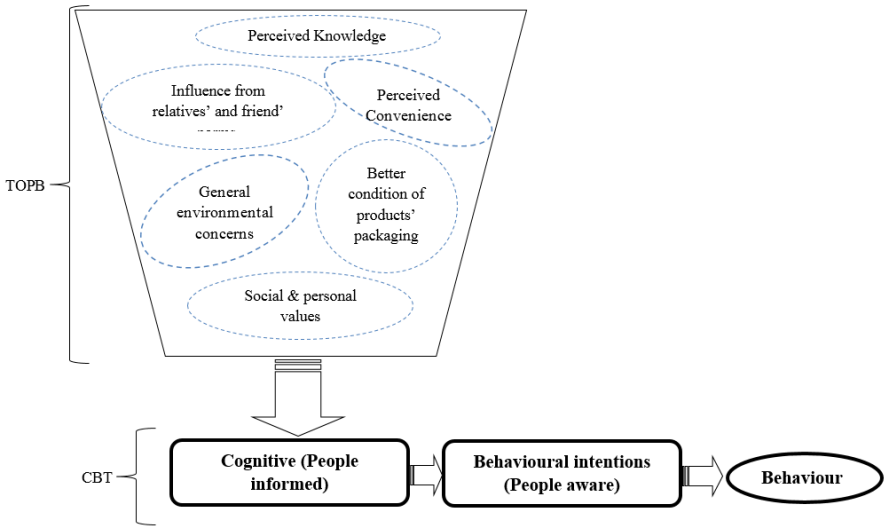

Figure 4-1: SBAF showing the relationship between CBT and TOPB

The SBAF seeks to increase reuse of packaging practice through focusing on social aspects and the way people can participate in the packaging reuse activities. The SD method is used to build the model in order to understand a system of packaging reuse behaviour.

4.3 System dynamics method

4.3.1 Background of system dynamic method

The SD approach has its beginning in the 1930s when the servomechanism theory was discovered (Coyle, 1996). Servomechanism is a tool which produces feedback from output level to input level. In the 1950s, the SD approach was developed by Forrester (1961) into a computerised system, producing industrial dynamics, which has opened the door for general application of this methodology (Garcia, 2006; Forrester, 1961). In the 1960s, the SD method was used in social contexts and more recently it has been extended to different areas such as ecology (Coyle, 1996). SD is a methodology used to understand all variable changes over time through equations. If all variables have been modelled, the method will study the dynamic of the total number of variables in a system. The purpose of using the SD method is to link between the qualitative (a causal loop diagram) and quantitative models (Stock flow diagram, SD-based computer simulation model) (Qudrat-Ullah and Seong, 2010).

4.3.2 Existing approaches to analysing social behaviour and the importance of SD

During the literature review in the previous section, it was found that no past research has used the SD methodology for dealing with the interaction between characteristics of social aspects. Most studies used a statistical approach such as factor analysis, path analysis, Chi-square test, structural equation modelling, or confirmatory factor analysis (Barr *et al.*, 2001a; 2001b; Chu and Chiu, 2003).

However, there are many studies that have utilised an SD methodology for investigating various topics in relation to waste management system. For example, Richardson (1991) found that, in the history of SD, the concept did not only apply in physics and engineering but it was involved in decision making and social settings as well. In waste management system studies using SD, Dyson and Chang (2005) developed models by using SD for the prediction of solid waste generation in an urban area, using combinations of variables that influence solid waste generation. Also, Karavezyris *et al.* (2002) designed a model that incorporated qualitative variables which are difficult to measure to be used quantitatively to forecast solid waste generation. Ulli-Beer (2003) developed a model to analyse solid waste recycling. The model was based on a feedback theory about human behaviour and public policy. Sudhir *et al.* (1997) used a SD model to investigate various structures and policies for a sustainable solid waste management system in India. The model discovered that recovery cost and user fee are the most appropriate policy alternatives for waste management systems. For studies in construction and demolition waste management see Wang and Yuan (2008), Hao *et al.* (2007) and Chaerul *et al.* (2008). However, there is not any previous study investigating packaging issues using SD.

Thus, this method will be suitable for identifying the real state of social aspects in reuse of packaging and get close to the desired state of obtaining good behaviour towards reuse of packaging. This is because there are many advantages of the SD method compared with other methods as it provides understanding of the structural causes of a system's behaviour, which increases the knowledge of each element in the system (Wolstenholme, 1990). Moreover, the SD method studies the knowledge of the real world, and assesses the hypotheses and effectiveness of policy, and can accept complex and nonlinear structures (Richmond, 1989). In addition, the SD method has a long-term perspective which provides for the consequences of actions taken in the present. It is a

method that allows the reconstruction of any existing model or the addition of any important elements that make a difference to the model's behaviour (Garcia, 2006). The research will explain each step of SD separately, as Sterman (2000) has outlined a step-by-step approach to constructing a SD model in his book "Business Dynamic System Thinking and Modelling for a Complex World".

4.3.3 Causal Loop Diagram of Social Behaviour Aspect Model (SBAM)

Causal loop diagrams provide a language for expressing the system, and the physical as well as the information flows among various variables. By linking together several loops, the coherence of these loops gives us a story about a specific problem or issue. The causal loop diagram is a system theory loop which has two kinds of loop: 'Balance loop' and 'Reinforcing loop'. The balance loop can be described as the variables' influence in the loop keeping things in equilibrium or a change in one element sets in motion a chain of events around the loop that eventually produces a counteracting influence on that element (e.g. if there is less nicotine in cigarettes, the smokers will consume more in order to get their dose), while the reinforcing loop means the variables' relationships within the loop create growth or collapse or, in another definition, a change in one element sets in motion a chain of events around the loop that eventually produces a reinforcing influence on that element (e.g. the more interest on a bank account, the more savings obtained). Each arrow in a causal loop is labelled with '+' or '-', where '+' means that if the first variable changes then the second variable will be changed in the same direction, whereas '-' means that if the first variable changes the second variable will be changed in the opposite direction – as shown in Figure 4-2 (Garcia, 2006; Sterman, 2000; Yuan, 2012; Yuan *et al.*, 2011). The model is created through a number of loops. It includes a reinforcing and a balancing loop with their interaction to provide networks of loops.

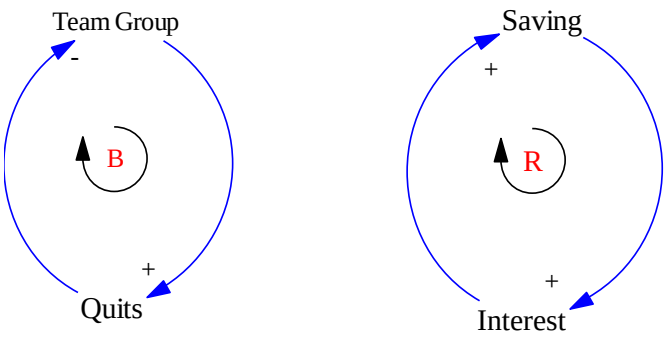

Figure 4-2: A simple example of causal loop diagram notation

Increasing packaging reuse practices would be achieved by concentrating efforts on enhancing packaging reuse among society. To enhance packaging reuse behaviour, conducting a reuse programme as a solution would be necessary. Based on the framework in Figure 4-1, social aspects that contribute to packaging reuse practices will be modelled. The indicators of social aspects of reuse of packaging are interrelated through TOPB and across different groups as follows:

- General environmental concern.
- Personal and social values.
- Influence from relatives and friend' norms.
- Perceived knowledge.
- Perceived convenience.
- Better conditions of product packaging.

As illustrated in Figure 4-3, the conceptual causal loop diagram has been constructed. The conceptual model in a causal loop comprises one positive feedback loop (R) and one negative loop (B). The behaviour of the system is determined through the dynamic interactions between these positive and negatives loops. As the packaging reuse programme is being conducted, it would decrease non-practitioners' reuse of packaging by increasing their initiative to participate in reuse schemes.

In negative loop B in Figure 4-3, it can be seen that increasing practitioners of packaging reuse has a direct impact to decrease non-practitioners of packaging reuse, as demonstrated in Axiom 1.

Axiom 1: Practitioners in packaging reuse - Non-Participation in packaging reuse.

The research used the CBT concept to construct the positive loop R in Figure 4-3. CBT can help to change people from cognition to behaviour. Hence, this research used this concept to design the positive loop, which consists of people informed about packaging reuse, people aware about packaging reuse and practitioners in packaging reuse. As the packaging reuse programme is being conducted, it would give people more information about packaging reuse; it would increase the number of people who know about packaging reuse but not change their attitude. That is, they know about but do not care or are not bothered about the incentives. Then increasing awareness would increase the

number of people who are aware about reuse of packaging and change their attitude although they are not actually doing anything yet. After that, increasing behavioural adaptation would increase the number of participants in packaging reuse and reduce the number of non-participants. This process is clearly described in Axiom 2.

Axiom 2: People who know about packaging reuse $\xrightarrow{+}$ People who are aware about packaging reuse $\xrightarrow{+}$ Participation in packaging reuse.

With reference to the above two axioms, which are demonstrated on a causal loop diagram in Figure 4-3, the stock flow diagram is utilised using these axioms to build the model.

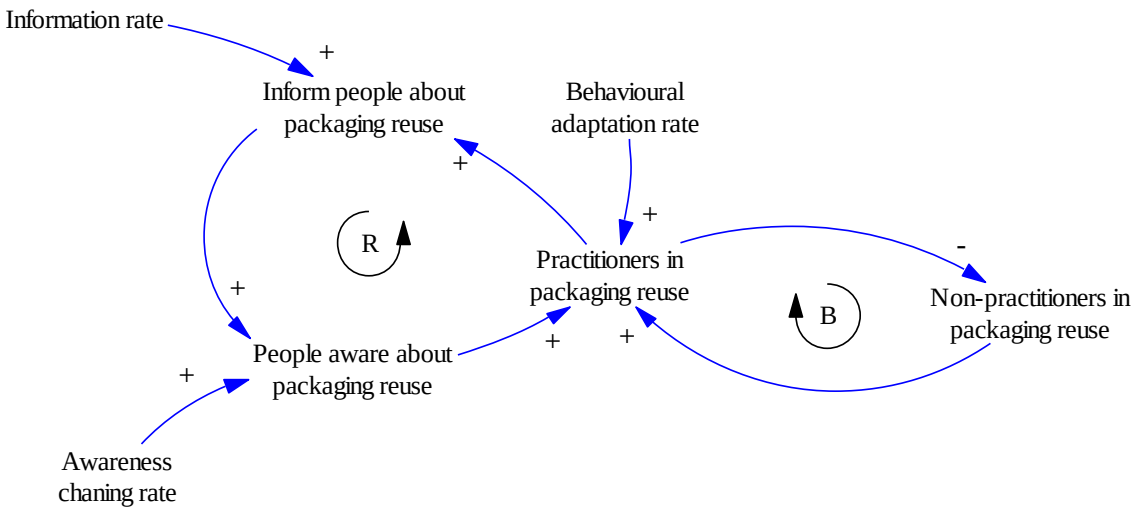

Figure 4-3: Causal Loop of SBAM showing the relationship between the factors

4.3.4 Model hypotheses

There are four hypotheses formulated to construct the model with regard to the relationship between these variables. The knowledge about the importance of environmental practices and their relation to reducing environmental problems has emerged in various studies. Hence, the first hypothesis can be formulated to be: Hypothesis 1: If the perceived knowledge about packaging reuse influences is related to people's ignorance about packaging reuse, then the packaging reuse is dependent on knowledge and communication in favour of reuse.

As the awareness about environmental issues and values is considered in many studies to be the important factor to enhance environmental behaviour such as recycling,

composting, etc., it would lead to conserving the environment and change attitudes and behaviour towards packaging. Moreover, social and personal values are the suitable incentive to change for better behaviour, as found in many studies which stated that if the consumers find a useful reward to carry out any pro-environmental practices, it would motivate them to perform environmentally friendly practices. Hence, the second hypothesis can be formulated to be: Hypothesis 2: If the general environmental concerns and social and personal values are related to people's ignorance about packaging reuse, then the packaging reuse is dependent on general environmental concerns and social and personal values behind packaging reuse.

In addition, community activities have shown in the literature their importance in increasing environmental responsibility amongst societies. As long as there are widespread environmental activities amongst societies, it would remove the doubt about these activities and increase the belief that these environmental activities can make a difference and add value to the environment. These positive feelings can lead to increasing the number of packaging reuse practices. Hence, the third hypothesis can be formulated to be Hypothesis 3: If the influence from relatives and friends' norms is related to people's awareness about packaging reuse increasing, then reuse of packaging is dependent on norms. Furthermore, increasing the facilities to practise environmental activities has shown its effect in the literature for changing behaviour and attitudes towards such things as recycling and incineration. In reuse of packaging, enhancing using reusable packaging requires widespread availability of reusable packaging products in the market with various functions. These functions can attract the consumers to reuse the packaging. Hence, the fourth hypothesis can be formulated to be: Hypothesis 4: If the better condition of product packaging and perceived convenience to packaging reuse is related to practitioners' behavioural adaptation to reuse packaging, then the reuse behaviour is dependent on availability of reusable packaging and the convenience during reuse.

4.3.5 Stock flow diagram of SBAM

The difference between a causal loop diagram and a stock flow diagram is that the causal loop diagram depicts a good understanding of the problem whereas the stock flow diagram expresses the equations and allows the model to be simulated by conducting quantitative analysis (Coyle, 1996). The stock flow diagram consists of

three main elements: stock, flow, and convertor, as shown in Figure 4-4. The level (stock) is the element that shows the state of the model. The flow is the element that can be defined as a time function. The flows describe the variations of the levels as flow-in, which are increasing the main element in the model, and flow-out, which are decreasing the main element in the model. Flow behaviour is a driver which delivers information from stock. The convertors are auxiliary variables that allow a better visualisation of the variables that are influencing the behaviours of flows (Garcia 2006; Yuan *et al.* 2011). The connector, which is a transmitter, connects between elements as an arrow.

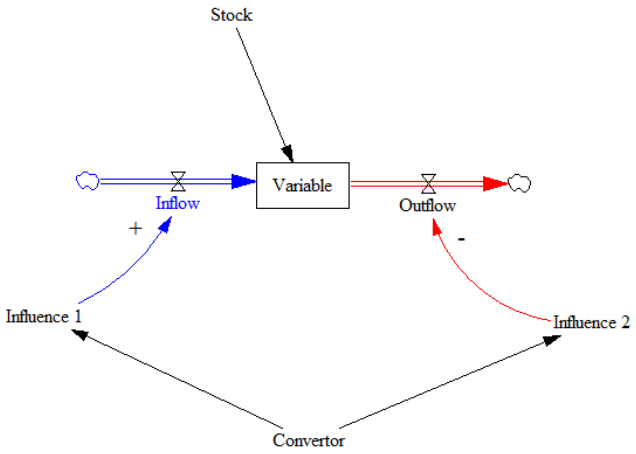

Figure 4-4: A simple system dynamic model by software VENSIM

To formulate a stock flow diagram, it is important to build the conceptual model, which is known as a causal loop diagram. The most appropriate way of converting a causal loop diagram into a stock flow diagram is by using a software simulation. There are a number of software packages such as Vensim, Dynamo, iThink, Powersim and Stella. The main advantage of software enables the designer to avoid having to formulate non-linear relationships mathematically. In addition, the SD method needs the set of approximate values in order to obtain an initial idea of the behaviour of the model, such as quantitative data which were obtained during the empirical study. Hence, the stock flow diagram is asking for given numerical values to identify the degree of accuracy for the model and define the interrelationships with the whole model mathematically. After the model is completed and ready for simulation when the parameters and the initial values for the variables have been specified from real data or case study or questionnaire, the simulation output will be a graph explaining the relationship between variable and time. Hence, in this chapter, the social aspects of reusing packaging are definitively determined when the parameters are known.

These paragraphs describe the model in Figure 4-5 in detail; the research used CBT to construct the main parameter of the model. As CBT focuses on the behaviour changing from irrational thinking to positive change to desired behaviour, hence this model arranges this theory into the three main parameters, which are people informed about packaging reuse, people aware about packaging reuse and practitioners in packaging reuse. In addition, the research used TOPB to show the factors that can influence the CBT parameters, which are general environmental concerns, perceived knowledge about packaging reuse, personal and social values, influence from relatives and friend' norms, better conditions of product packaging and perceived convenience. These parameters and factors combined with the effect of encounters with reuse practitioners can determine how long it takes uninformed people to become informed about packaging reuse.

The information rate is the amount of information that the participants received about reusable packaging per time unit. The domain experts in the area set the time rate for people to become informed, which is 30 days. 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. This is accumulated in awareness-changing rate with time rate. Awareness-changing rate is the amount of awareness-changing per time unit. The domain experts in the area set the time rate for awareness-changing amongst people, which is 30 days. 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 within time rate. Behavioural adaptation rate is the amount of behavioural adaptation per time unit. The domain experts in the area set the time rate for people to adapt, which is 30 days. As the change of consumers' behaviour from being non-informed about packaging reuse to becoming practitioners of reusing packaging could take more time, therefore, the model considered the delay function in information rate, awareness-changing rate and behavioural adaptation rate, as shown in the equations section. The domain experts in the area set the delay, which is 30 days. For the sake of understanding the model assumptions and parameters, all detailed

descriptions of the variables and variable units in the model are appended in Appendix I.

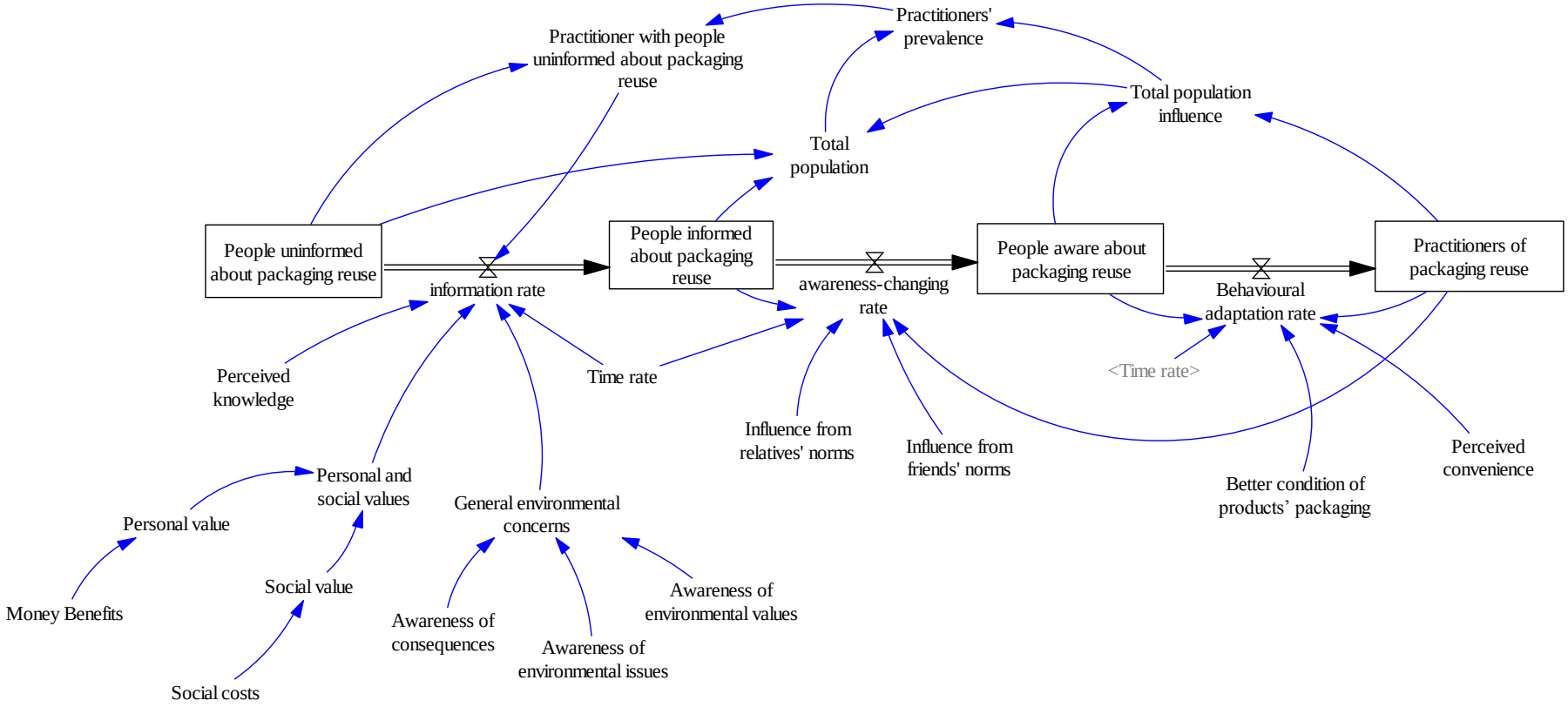

Figure 4-5: SBAM showing the interaction between the factors

4.3.6 Equations

In order to simulate the model, it is necessary to create equations that describe the relationship between variables, defining one variable in terms of others that are causally connected. These equations are simple algebraic expressions. The complexity of the SD system method appears throughout combinations of equations when linking sub-models together to simulate the whole system. The model is constructed using some dynamic functions, such as (INTEG)[1] and (DELAY FIXED)[2]. All model equations contained in this model are as follows:

People uninformed about packaging reuse = INTEG (-information rate, 91[3])

General environmental concerns = Awareness of consequences + Awareness of environmental issues + Awareness of environmental values.

Personal and social values = Personal value + Social value

Behavioural adaptation rate = DELAY FIXED ((Practitioners in packaging reuse + Aware people about packaging reuse + Perceived convenience + Better conditions of product packaging) / Time rate, 30[4], 0.01[5])

Information rate = DELAY FIXED ((Practitioner with Non inform people about packaging reuse + Perceived knowledge + General environmental concerns + Personal and social values) / Time rate, 30, 0.01)

Awareness-changing rate = DELAY FIXED ((Practitioners in packaging reuse + people Informed about packaging reuse + Influence from friends' norms + Influence from relatives' norms) / Time rate, 30, 0.01)

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[1] INTEG (Rate, Initial value) = $\int_{\text{Initial value}}^{n} Rate$, The rate is numerically integrated.

[2] DELAY FIXED (Input, Delay time, Initial value), returns the value of the input delayed by the delay time.

[3] Number of people uninformed about packaging reuse. This number is extracted from the questionnaires.

[4] See section 4.5.5 for information.

[5] 0.01 is the initial value of the delay function. Initial value of the delay function should be much smaller than 1 as result 0.01 was used in the study.

Total population influence = Practitioners in packaging reuse + people aware about packaging reuse

Practitioners' prevalence = Total population influence / Total population

People informed about packaging reuse = INTEG (Information rate – Awareness-changing rate, 0)

People aware about packaging reuse = INTEG (Awareness-changing rate - Behavioural adaptation rate, 0)

Total population = people uninformed about packaging reuse + people informed about packaging reuse + Total population influence.

Practitioners in packaging reuse = INTEG (Behavioural adaptation rate, 10^6)

Practitioner with people uninformed about packaging reuse = practitioners' prevalence * people uninformed about packaging reuse.

Time rate = 30 days[7].

4.4 Empirical study of the relationship between people's behaviour and reusable packaging

AS the research aims to explore people's behaviour related to reusable packaging, an SD model is created and then need set of values in order to simulate the model. An empirical study was conducted by designing a questionnaire.

4.4.1 Questionnaire formulation and structure

The survey was developed in accordance with the design principles suggested by Forza (2002). The survey was based on a 5-point Likert scale to present the degree to which the individual respondent attempted to reuse waste packaging. The scale ranged from never to very frequently. This section examines the variables that will be presented in the SD model and justifies the questionnaire items chosen to measure these variables in

[6] Number of participants who practise reuse of packaging. This number is extracted from the questionnaires.

[7] See section 4.5.5 for information

the survey. The survey is presented in Appendix II. The questionnaire designed based on the content from the literature review which rely on the theories. The questionnaire constructed also based on how the previous studies had measured the variables, which can increase the credibility of data as shown in the following paragraphs:

Social demographic: community residents were asked about social-demographic factors including gender, age, members in family, education level, job level, year of residence, personal norm and type of product that they reused. It assesses the representativeness of the sample by comparing the demographics of the sample with the demographics of the country. Many studies in waste management have assessed social demographics, especially recycling studies and a few looking at reuse (Vicente and Reis, 2008; Arcury *et al.*, 1987; Reschovsky and Stone, 1994; Schultz *et al.*, 1995; Hornik *et al.*, 1995; Ebreo *et al.*, 1999; Jenkins *et al.*, 2003; Edgerton *et al.*, 2008).

Reuse behaviour towards reuse of packaging: this section in the survey assessed the residents' behaviour towards reuse of packaging directly by a composite method. Self-reported behaviour was used to identify people's reuse of packaging behaviour. Respondents were asked whether they had participated in reuse of packaging activity during the previous week. Respondents were asked the type of various materials they had reused. Verdugo and Figueredo (1999) used self-reported behaviour to obtain true reuse behaviour. However, in recycling, Valle *et al.* (2005) and Ebreo *et al.* (1999) also measured recycling behaviour by using self-reported behaviour with a composite method.

Reuse attitude towards reuse of packaging: the attitude towards any waste tackling can be obtained whether individually or against behaviour in a specific manner. In recycling research, the recycling attitudes measured by the composite method (Ajzen and Fishbein, 1975; Vicente and Reis, 2008; Schwartz, 1977; Valle *et al.*, 2005; Ebreo *et al.*, 1999) measured recycling attitudes using a New Environmental Paradigm (NEP) (Practical Action Nepal) (VanLiere and Dunlap, 1980). The NEP was used to measure environmental concern and represented the world as consisting of a harmonious system between the environment and humanity. Also, some research used a direct measure, which considered individual judgment of performing the behaviour (Hopper and Nielsen, 1991; Taylor and Todd, 1997). In reuse studies, Mosler *et al.* (2008) measured reused packaging attitudes by a composite method and measured sentiment and cost-

value ratio. In this chapter survey, the research used a composite method and measured sentiment towards reusing packaging, whether it would be pleasant to reuse packaging, and the survey measured whether reuse of packaging adds value for participants.

Social and personal norms: social norms have been measured using a composite method in many studies, as proposed by Ajzen and Fishbein (1975). In recycling research, Valle *et al.* (2005), Vicente and Reis (2008), Barr *et al.* (2007) and Chu and Chiu (2003) measured recycling norms by a composite method. Social norms originate from internal reference, such as parent, relative, friends and neighbours, and from external reference, such as organisation or social group. This study combined the two sources of social pressure from internal and external references. Personal norms drive the beliefs personally held with regard to how someone should behave. If the participants reused packaging, it would create a sense of satisfaction; however, if not, it would lead to a feeling of guilt. The survey measured subjective norms through 12 questions about the influence of social and personal behaviour towards reuse of packaging. The mean of these 12 questions was used as the direct measure of social and personal norms.

PBC: the definition of PBC is a result from the product of the beliefs regarding the difficulty to perform the behaviour and the controllability of the performance of that behaviour (Ajzen and Fishbein, 1980). Mosler *et al.* (2008) compared waste disposal behaviour and derived specific intervention by involving perceived difficulty of recycling waste as a latent variable. Perceived convenience of packaging reuse is a vital variable that constrains PBC (Valle *et al.*, 2005). This study measured perceived convenience by a composite of two features. The first assesses the actual availability of product packaging to be reused. The other measure indicates the satisfaction level of packaging reuse in terms of packaging condition and adequacy of information provided. The study measured PBC by using a composite method and the survey included 11 questions to find out the influence of concentrating on behaviour control to enhance packaging reuse. The mean of these 11 questions was used as the direct measure of PBC.

Perceived knowledge: perceived knowledge about waste tackling is a latent variable which reveals the individual use. In recycling, Valle *et al.* (2005) examined specific knowledge about the understanding of the different classes of materials and proper

discarding process (Barr *et al.*, 2001a; Edgerton *et al.* 2008; Scott, 1999). In this study, because reuse of packaging is not commonly practised by Saudi nationals, specific knowledge about when the product's packaging can be reused, how many times and how to get rid of packaging were examined through six questions during the survey. Communication is another vital way of conveying a message to consumers. In recycling studies, Vicente and Reis (2008) and Valle *et al.* (2005) examined the influence of direct media on household recycling behaviour. Television, radio and newspapers are the main mediums considered in this study. The mean of these six questions was used as the direct measure of perceived knowledge.

Perceived personal and social value: the attitudes towards a specific behaviour are relational to the sum of beliefs about the relevant attitudes and perceived consequences of performing the behaviour (Chu and Chiu, 2003). For example, someone might believe that reuse of packaging will result in less environmental pollution. If the consequence is positive, it would make someone's attitude towards reuse of packaging more active. There are a lot of studies that have identified factors that affect attitudinal beliefs of recycling or other environmental behaviours (Hopper and Nielsen, 1991; Oskamp *et al.*, 1991; Taylor and Todd, 1997; Vining and Ebreo, 1990). The work of Chu and Chiu (2003) divided attitudinal beliefs of recycling into two components: personal values and social values. This study about reuse of packaging also divided the attitudinal beliefs into two groups. The study measured personal values through two indicators related to personal benefits from reusing packaging such as money and affecting children's behaviour. Social values were measured through five indicators related to: save natural resources, reduce environmental pollution, reduce social cost, reduce the load on waste management and show my participation in society. The study used measured personal and social values by a composite method of 10 questions. The mean of these 10 questions was used as the direct measure of perceived personal and social value.

General environmental concern: environmental concern is a latent variable considered in previous studies of recycling or any environmental behaviour. In recycling, Valle *et al.* (2005) and Ebreo *et al.* (1999) showed that broad attitudes towards the environment are well captured by using NEP (VanLiere and Dunlap, 1980). In this study, environmental concern was measured using a composite method through five questions where the community residents were asked about their awareness about environment

issues and values, whereas the awareness of consequences of packaging reuse activities was measured by a direct measure which considered only the individual's positive or negative judgment of performance of behaviour. The mean of these five questions was used as the direct measure of general environmental concern.

4.4.2 Questionnaire process and data collection

The questionnaire was designed by the Questionnaire Designer website, which generated a link. This link is suitable for online distribution to people. The questionnaire was piloted with five participants and then refined before the questionnaire link was distributed online to a group of students as well as non-students, employees and non-employees. In addition, the questionnaire link was diffused through social networks such as Facebook and Twitter from April 2013 to May 2013. In turn, those participants were asked to forward the questionnaire link to as many people as possible. The questionnaire strategy used is the snowball sampling concept. The average time for responding should be between 8 and 10 minutes. In order to assess the presence of non-response bias, the assumption is that respondents who responded with some missing data were likely to be considered non-respondents (National Research Council, 2013). Quantitative data collected in the questionnaire was to be used in the development of the SD model. The author noted that 300 participants attempted the questionnaire. Of these, 101 were completed and the others rejected owing to being uncompleted. The response rate was 33.67%.

4.5 Statistical results

4.5.1 Questionnaire analysis

From the questionnaires, the research found that there are 10 people who practise reuse of packaging while there are 91 people who are uninformed about packaging reuse. As shown in Table 4-1, most of the participants are male and well educated. Approximately 55% of people did reuse glass and steel packaging. Some of them mentioned that they reused cartons and plastics waste. The disposal behaviour is a prevalent attitude amongst the participants and a quarter of them performed waste recycling. The participants' level of job is from new employee to senior employee, which represents around 70% of the whole sample. Around 70% of participants have resided within the same community for less than 7 years, while the number of family members is between 2-5 persons, which represents around 64.29% of the total. According to the participants'

behaviours obtained from the questionnaire, the participants are rarely committed to reusing packaging and seldom reuse packaging for its original use; however, they occasionally reuse packaging for other uses. In addition, according to the participants' attitudes, the participants agreed that reusing packaging adds value for them and creates pleasant feelings; further, participants disagreed that reusing packaging is meaningless; rather, they strongly agreed that reuse of packaging is a good approach to tackle packaging waste before disposing of it.

Table 4-1: Demographic characteristics of the sample

Characteristic	**Distribution of Answers**
Respondent's gender	(Male) 80.61% ; (Female)19.39%.
Respondent's age	(21-30) 56.12% ; (31-40) 38.78% ; (over 41) 5.10%.
Respondent's education level	(No Education) 1.02% ; (School) 3.06% ; (Bachelor) 41.84% ; (Master+) 45.92% ; (PhD) 8.16%.
Respondent's job level	(Beginning employee) 11.22% ; (Middle employee) 38.78% ; (High employee) 13.27% ; (Senior employee) 8.16% ; (Non-employee) 28.57%.
Respondent's years of residence	(1-3 years) 38.14% ; (4-7 years) 30.93% ; (8-11 years) 2.06% ; (over 12 years) 28.87%.
Respondent's members in family	(Only 1 person) 18.37% ; (2-5 persons) 64.29% ; (6-8 persons) 14.29% ; (9 persons or more) 3.06%.
Respondent's product reused	(Glass) 42.42% ; (Clothes) 35.61% ; (Steel) 15.15% ; (Plastic) 6.32%.
Respondent's personal behaviour	(Recycling) 28.95% ; (Composting) 5.26% ; (Reuse) 8.77% ; (Disposal) 57.02%.

The average number of people who were influenced to reuse packaging is shown in Table 4-2, as found from the participants' responses. These variables are influenced from norms (friends and relatives); knowledge about packaging reuse; awareness about environmental issues, values and consequence; personal and social values; and behaviour control (perceived convenience and better condition of product packaging).

Table 4-2: Average number of people who were influenced to reuse packaging from questionnaire data

Influence from		**Influence from**	**Influence from awareness about environment**			**Influence from**		**Influence from**	
Friends' Norms	Relatives' Norms	Perceived knowledge	Issues	Values	Consequence	Personal value	Social value	Perceived convenience	Better condition of product packaging
2.31	2.18	2.90	3.46	3.46	3.36	3.12	3.27	2.86	3.10

From Table 4-2, the results from the questionnaire show that there is good awareness amongst participants about environmental issues and values, and also knowledge about the consequences of reuse of packaging; however, there is low knowledge about packaging reuse itself. In addition, participants are little influenced by norms whereas they are normally affected by personal and social values. Finally, perceived convenience about reuse of packaging also has low influence on people becoming practitioners of packaging reuse.

4.6 Simulation processes and results of SBAM

The proposed model was run for a 120-day period. In order to run the proposed model, from Table 4-2, the average values are the constant values which need to be inputted into the proposed model in order to obtain the SD behaviour.

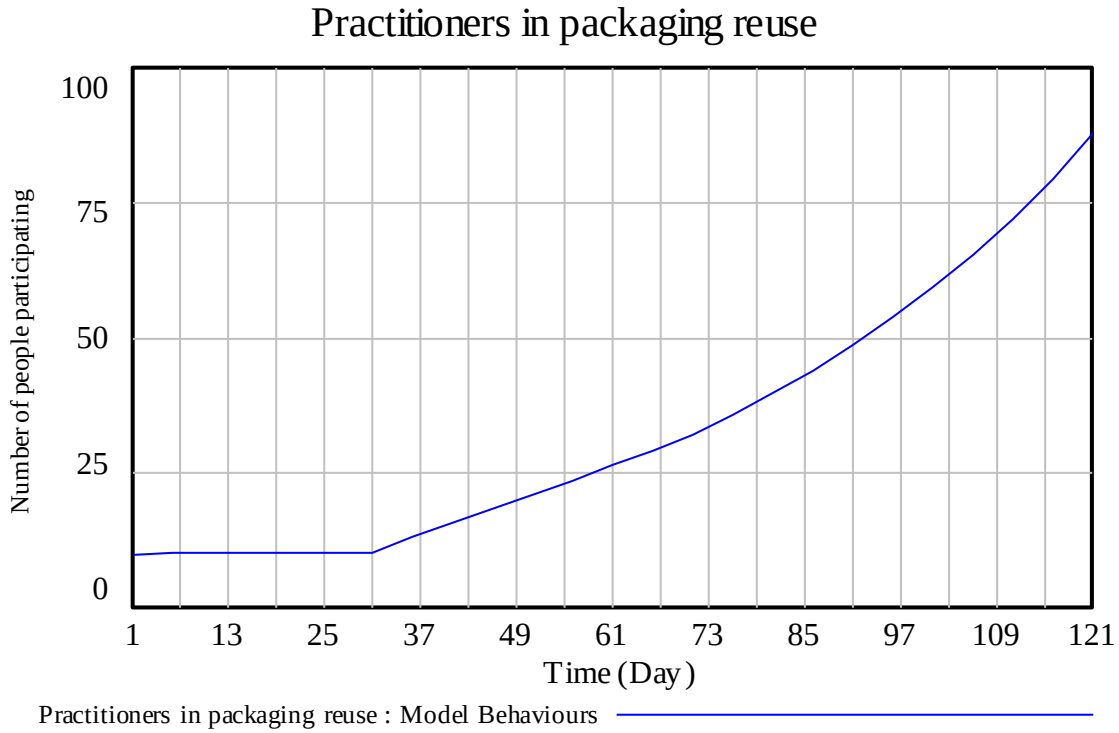


Figure 4-6: The growth in the number of people who participated in reuse after 121 days of the simulated SBAM.

The proposed model is run from day 1 to day 120 with a Time Step at 1. The proposed model generates the following behaviour, shown in Figure 4-6. The proposed model diverges after day 31 with pure exponential growth. In the proposed model's behaviour, the controls of model behaviour are devoting attention to information, awareness-changing and behavioural adaptation rates which lead to growth in the number of people who participated in packaging reuse. Therefore, the results show the interaction between

the variables in the model with regard to people moving from being non-participants to participants in the reuse of packaging.

4.6.1 Validation of the structure and behaviour of SBAM

The validation process is a very important task in order to test the model. These validation test steps include a boundary test, structure verification, dimension consistency, parameter verification, extreme conditions and structurally oriented behaviour test, as shown in Qudrat-Ullah and Seong's study (2010).

- Test 1 Boundary test: in this test, all variables considered in social factors have been embodied in the model, and each variable is critical to the research purposes to discover social behaviours.
- Test 2 Structure verification: this test is concentrated on the causal loop diagram for the model. As illustrated in Figure 4-3, all cause and effect chains in the diagram are gleaned from existing studies or based on acknowledged perception and literature reviews.
- Test 3 Dimension consistency: as mentioned in the stock flow diagram section, this test is obtained using the Vensim software. Hence, the results confirm that the model has been validated for dimension consistency.
- Test 4 Parameter verification: the values assigned to the model parameters are sourced from a real case study.
- Test 5 Extreme condition: in this test, the research examines the model by using the entire variables for the extreme condition test. The aim is to simulate the fastest growth possible for participants from the model; in other words, how the number of participants of reuse will change during the application of the extreme value of all variables.

The above variables are all quantitative variables where 0 indicates that the participants have no influence and 5 indicates that the participants have the highest influence. The model will test the effect of this influence on all the variables. It can be seen from the results presented in Figure 4-7 that if there is no influence on all the variables, the number of people practising packaging reuse is 100 at the end of day 120. However, the extreme value of influence on all the variables will increase the number of people practising packaging reuse to 170 at the end of day 120. Based on the above tests, the

model can be trusted and used for further simulation during the application of empirical study data. Moreover, the model has the ability to generate the right behaviour for the appropriate reasons.

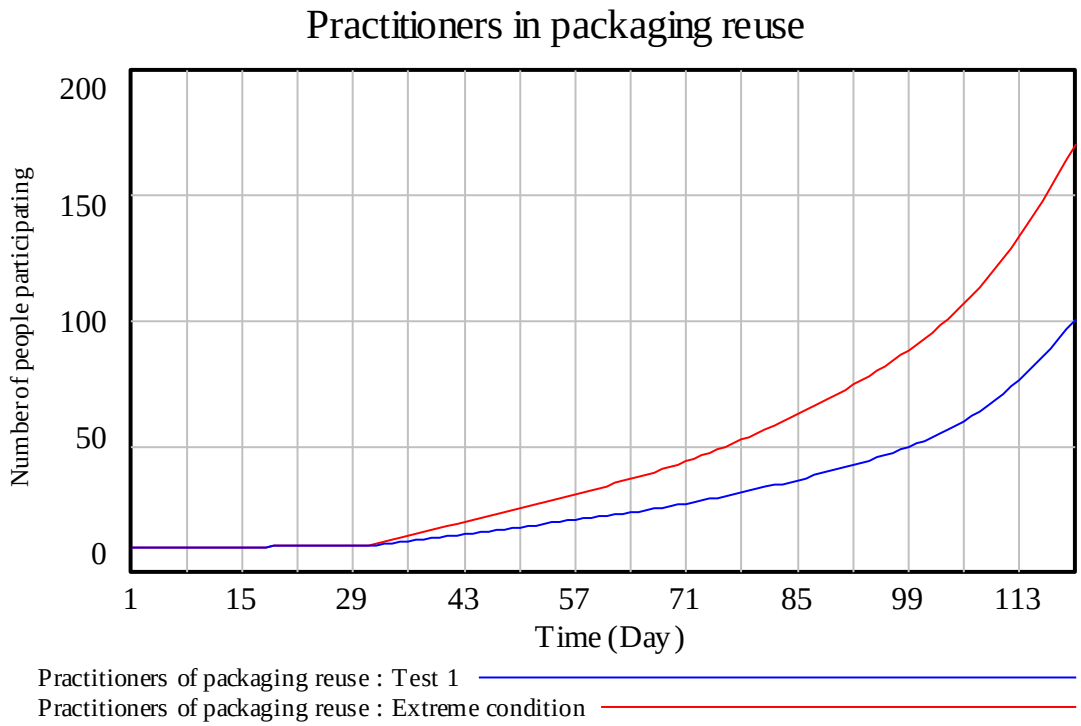


Figure 4-7: An example of an extreme condition test for the model and the behavior of basic and extreme condition simulation.

For behaviour validation, the main aim is to compare model behaviour to the observed behaviour of the real system. There are some studies that have tested the model by comparing the model behaviour to behaviour reported in the literature or to real results. For instance, in a municipal solid waste management model (Talyan *et al.*, 2007), the study examined the behaviour of an SD waste management model with the available data from the literature, which was from 1991 to 2001. After that, the Talyan *et al.* model showed good consistency with the actual values. Also, another study tested the behaviour of an urban solid waste management model among the various components with the estimates relating to elements such as the amount of waste generated and the number of waste pickers and the study showed that the model produced similar behaviour to the estimated values (Sudhir *et al.*, 1997). For another example see Barlas' study (1994). Owing to there being no previous data on packaging reuse to make a comparison between real data behaviour and simulation behaviour, the research will only rely on the SD validation process which most of previous studies follow.

4.7 Results of scenario analysis

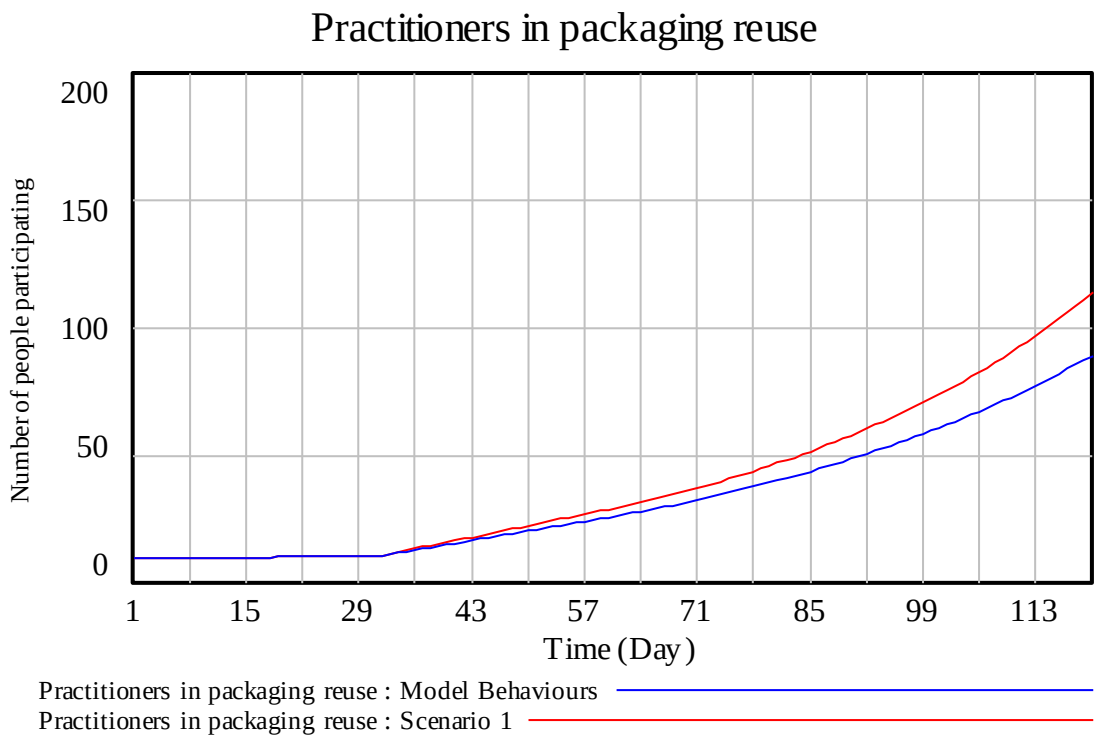
The low value of variables that have an impact on social behaviour (as shown in Table 4-2) during the simulation period will be investigated further, by creating scenarios that allow some control of these variables. The created scenarios help in determining which variable is less dependent on others. However, according to the proposed model results in the case study, the scenarios encompassing three variables (influence from norms (friends and relatives), influence from knowledge about packaging reuse and influence from behaviour control (perceived convenience and better condition of product packaging) that have low values, as shown in Table 4-2, are designed as follows:

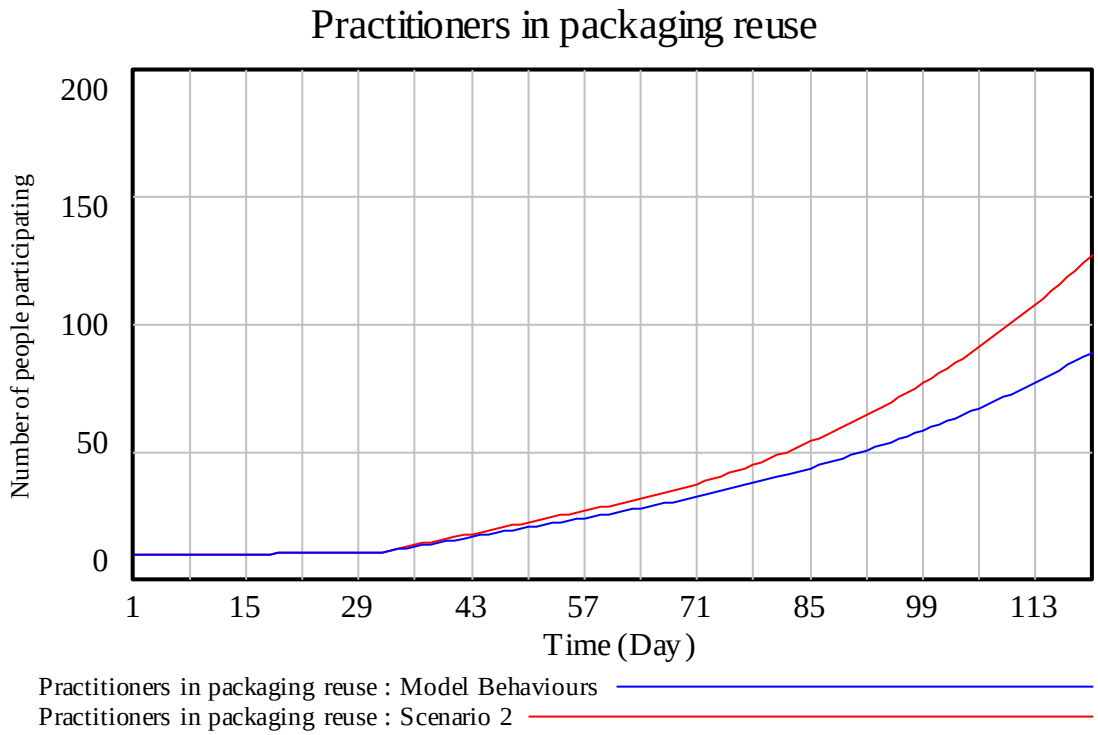
- Scenario 1 (S1): investigates whether concentrating on increasing the perceived knowledge about packaging reuse would enhance the uninformed people to be aware about packaging reuse.
- Scenario 2 (S2): considers whether a focus on increasing relatives and friends' norms would contribute to an increase in people who are aware about packaging reuse.
- Scenario 3 (S3): looks at whether concentrating on increasing the better condition of product packaging, perceived convenience to reuse packaging and S1&S2 would be helpful in convincing people to participate in packaging reuse.

It is shown that S1 and S2 are single-policy scenarios whereas S3 is a multi-policy scenario. Scenario 1 is to test how changes in the perceived knowledge about packaging reuse will encourage people to participate in reusing packaging practices. The increase in the perceived knowledge about packaging reuse in the empirical study was 2.89 and the scenario assumes that the knowledge average will be improved to 5 and time rate will be reduced to 25 days instead of 30 days. Scenario 2 is to test how a change in relatives and friends' norms would increase the number of people who are aware about packaging reuse. The scenario assumes the relatives and friends' norms are developed to a value of 5 and also that the time rate will be reduced to 25 days instead of 30 days. Finally, scenario 3 focuses on the better condition of product packaging and perceived convenience to reuse packaging and how to develop it to contribute to enhance packaging reuse participation. The results show that in S1, after increasing people's perceived knowledge about packaging reuse and reducing the time rate for people to be

informed, it would slightly increase the number of people who were informed about packaging reuse. As shown in Figure 4-8, although all the participants gained more knowledge about packaging reuse than usual, there was not that much difference from participants with existing knowledge about packaging reuse. This is because the condition of product packaging, perceived convenience to reuse packaging and influence of relatives and friends' norms on packaging reuse are not improved simultaneously. The results show that there are 113 participants in reusing packaging, which is an increase compared to 90 participants in the basic simulation.

The results demonstrate that in S2 (shown in Figure 4-8), the number of people influenced to be aware about packaging reuse has grown. The results show that the number of people who are practising packaging reuse reached 127 participants at the end of day 120; whereas in the case study this had reached 90 persons at the end of the same day. In scenario 3, the results in Figure 4-8 show that the number of practitioners who reuse packaging increased from 90 to 143 people at the end of 120 days. This is a significant improvement in the number of practitioners after educating people about packaging reuse, enhancing norms and facilitating packaging to be reused. Although the above scenario results provide valuable insights into the importance of enhancing packaging reuse, it is worth highlighting that these scenarios are by no means exhaustive since there are several scenarios that can be devised and simulated using the model.


Practitioners in packaging reuse
200
150
100
50
0
Number of people participating
1
15
29
43
57
71
85
99
113
Time (Day)
Practitioners in packaging reuse : Model Behaviours
Practitioners in packaging reuse : Scenario 1


Practitioners in packaging reuse
200
150
100
50
0
Number of people participating
1
15
29
43
57
71
85
99
113
Time (Day)
Practitioners in packaging reuse : Model Behaviours
Practitioners in packaging reuse : Scenario 2

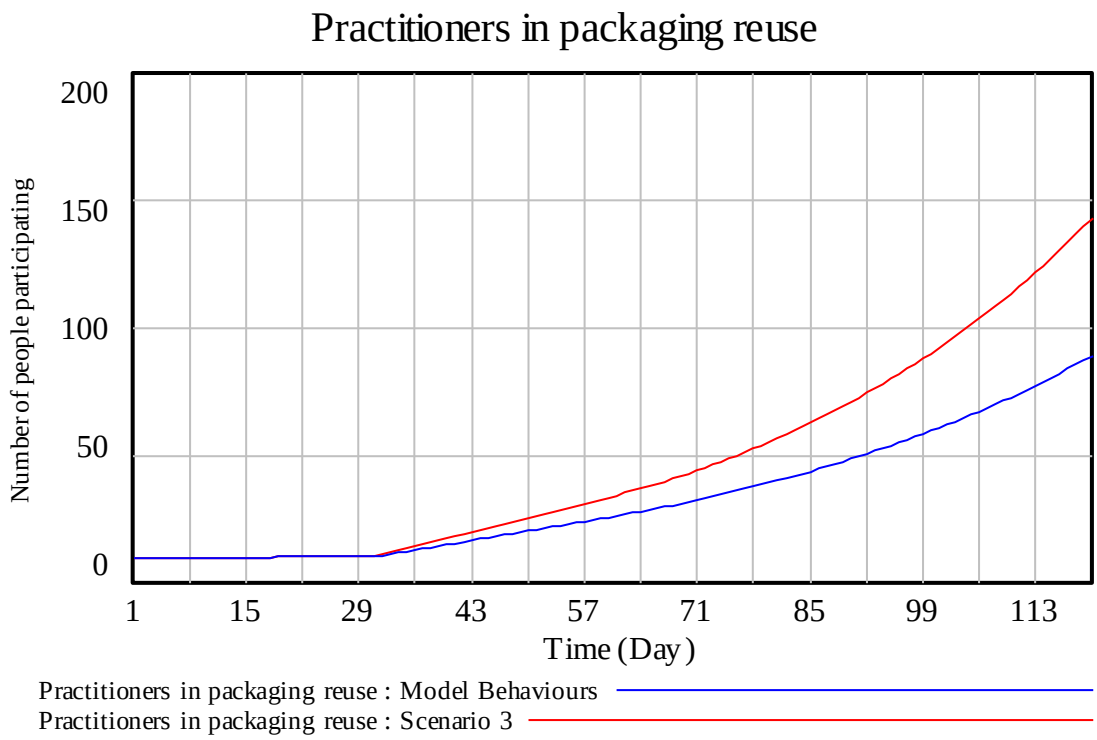


Figure 4-8: Results of the three scenarios compare with the basic simulation

4.8 Discussion

Most of the models investigated in previous studies were in recycling, some considered composting and a few studies talked about reusing packaging in terms of comparison between the 3Rs (Recycling, Reusing and Reducing). Reuse behaviours have a different characteristic from recycling in some variables, as will be shown later in this section.

Four hypotheses were used to construct the stock flow diagram. Hypothesis 1 maintained that perceived knowledge about reusing packaging would influence people who were unaware about packaging reuse to be aware about packaging reuse. According to the proposed model results, knowledge about packaging reuse is tantamount to demonstrating people's participation in reusing packaging regardless of the experience; however, it is one of the variables that merge with other variables, which could lead to high participation amongst consumers. The results from the proposed model can confirm that perceived knowledge about packaging reuse raised people's understanding about packaging reuse within a short period. This result

corresponds with the results from recycling: people who have information about recycling are willing to recycle waste, around 14.1% (Vicente and Reis, 2008). Having information on reusing packaging not only aids greater motivation but it can also make reuse of packaging less difficult, which attenuates the feeling of being inconvenienced. The knowledge about packaging reuse is not less important than other variables. It can influence people's attitude behaviour, as found in various recycling studies (Vicente and Reis, 2008; Valle *et al.*, 2005; Chu and Chiu, 2003; Scott, 1999) .

Therefore, policymakers should establish a social centre which would improve people's knowledge of reusing packaging. Policymakers should make sufficient efforts to develop social marketing strategies in terms of telling people how to participate in reusing programmes, which can be achieved by TV advertising, mailshots, magazines, newspapers, flyers, SMS messages, email and also by social networks such as Facebook and Twitter, providing information on the effectiveness of participants' actions such as: How much waste has been reduced among the community by reusing packaging?. In this way, any misinformation that might be influencing people's participation could be investigated and people could be helped to make the connection between their contributions at home and the environmental improvement. Moreover, demonstrating the economic benefits of their participation could enhance the dedication of those who reuse packaging by focusing on cost saving. Further, as demonstrated in S1, after people develop knowledge about packaging reuse, the results show there was a slight increase in the number of participants aware about packaging reuse due to the weakness of other variables; however, in S1 the last stage of the CBT process showed that there is a slight decrease in the time period that participants take to become practitioners of packaging reuse. This occurred because there was no other development in S1, excluding knowledge about packaging reuse which is not enough in the whole process. Therefore, it is necessary for policymakers to improve every stage in the whole packaging reuse programme to avoid undesired results.

Moreover, hypothesis 2 maintained that the general environmental concerns and social and personal values would influence people who were uninformed about packaging reuse to become aware about it. It can be seen from the proposed model that those citizens who are aware of environmental issues, environmental values and consequences of packaging reuse have a significant impact on willingness to reduce waste by reusing packaging. As in S1 it was proved that development knowledge about reusing

packaging contributes to reducing the time period and increasing the number of people who reuse packaging. This study supports previous studies which have shown that consumers do seem to care about the environment (Bech-Larsen, 1996). Also, this result corresponds with recycling studies that concluded that people are aware of recycling's benefit to the environment, which might be encouraging consumers to try recycling (Bratt, 1999). These findings about people's belief in conservation and product nature all have a significant effect and need positive reinforcement. Therefore, policymakers should pay attention to improving householders' environmental responsibilities and awareness amongst people through education campaigns such as school courses and government programmes. For instance, one research study found that public environmental education leads to changing environmental attitudes, emotions and beliefs rather than simply improving knowledge of the subject (Pooley and O'Connor, 2000).

In addition, the results in the empirical study show the participants have high general environmental concerns whereas there is weak knowledge amongst participants about packaging reuse. Moreover, from the model's results, it is true that people engage in environmentally responsible behaviour as a way of reflecting their benefits from the engagement. However, social benefits also have an effect on people's participation. This refers to the fact that people's commitment to an activity will be observed and expected by the community, and another reason is to reduce societal costs. Hence, considering personal and social values would also influence people's knowledge about packaging reuse and increase the number of people who are in favour of reuse. Therefore, policymakers should focus on personal and social values in harmony when promoting households' reuse of packaging.

Hypothesis 3 maintained that relatives and friends' norms on reusing packaging influence people who are informed of packaging reuse to be aware. According to the results of the model, consumers who are influenced by relatives and friends are willing to reuse packaging. The subjective norms have a greater ability to influence reuse behaviour if there is awareness about the community's attitudes, which helps to change personal norms through influence from parents, neighbours and friends. Individual participation in reusing packaging has a more essential effect than recycling of waste due to the reuse perspective, which is created by consumers, and obviously reuse is more customary than recycling. Before society considers the reuse of packaging, it

should also look at areas such as reuse of items such as clothes before they become 'waste' items. Reuse means using the object in a different way from what was originally assumed when it was bought. A few studies have highlighted the importance of reusing waste. The research by Verdugo and Figueredo (1999) examined consumers' participation regarding reuse of items such as glass, clothing and metal, and found that clothing is the most common item people reuse, followed by glass and steel.

Moreover, the results from the model agree with Hopper and Nielsen's model (1991), which found that there are great influences between subjective norms and behaviours if there is awareness about consequences. Valle *et al.* (2005) had the same finding for recycling, where subjective norms have a direct effect on recycling behaviours. In addition, this research's results correspond with Bratt's research (1999), which found that actual consequences of recycling on an individual's behaviour might reduce the probability of personal norms inducing environmentally friendly behaviour.

In the model's results, a high relationship between relatives and friends' norms and behaviour to reuse packaging does not only depend on the general environmental concerns and social and personal values and perceived knowledge about packaging reuse; it was also found that relatives and friends' norms play an important role in enhancing packaging reuse. Therefore, it is time for policymakers to make all efforts towards disseminating reuse of waste programmes amongst society, such as designing a campaign to tell families, neighbours and friends or arranging a training programme to educate people, and then they will influence their families, friends and neighbours to reuse waste. For instance, in Nepal the Women's Environment Preservation Committee Organisation undertook a project with local communities to create clean and hygienic environments. The major focus was on educational campaigns and running school environmental training in order to raise awareness of waste issues. After these campaigns, the residents were aware that municipalities could not handle the problem of solid waste without people's co-operation (Practical Action Nepal, 2008).

Hypothesis 4 maintained that better condition of product packaging and perceived convenience to packaging reuse is related to practitioners' behavioural adaptation to reuse packaging, then the reuse behaviour is dependent on availability of reusable packaging and the convenience during reuse. Reuse of waste is planned behaviour by the consumers when they purchase the product: they intend to reuse it for the original

use or for other purposes; whereas recycling is not further planning behaviour: consumers may or may not participate in recycling schemes, which depends on the variability of the facilities provided. Reuse of packaging is not affected by the variability of facilities compared with recycling, e.g., see how kerbside recycling bins affect consumers' behaviours. However, the non-reuse of packaging could then be tackled with other methods such as recycling, landfill, etc. This result puts the emphasis on industry, which should consider reuse of product packaging during manufacture. Condition of product packaging to be reused must be maintained because, when the condition of product packaging is suitable to be reused, the ability of consumers to participate becomes higher and easier as well. In recycling behaviour, people who felt recycling was difficult had a negative feeling about participation – recorded at around 11.6% (Vicente and Reis, 2008). Some studies found that people who felt it was easy to access recycling bins had a higher percentage of participation than people who felt they were too distant from recycling bins (Barr *et al.*, 2001a).

Therefore, policymakers should focus on product attitudes that are related to reuse in some way; for example, purchase of products in reusable packaging has a direct influence on consumers' behaviours due to its having a particular environmental benefit and it enables people to easily engage in conservation behaviour. From the psychology point of view, given the theory of cognitive dissonance, Festinger (1957) suggests that our attitudes and beliefs move in harmony and avoid dissonance. It is still possible for reusing behaviour to influence attitudes and norms when reusable product packaging is present; otherwise, when reusable packaging functions are absent, the reuse behaviour would imply a significant dissonance. Therefore, this study confirms that, if there is concentrated effort on developing behaviour control of reusing packaging, reuse behaviour has a direct connection between personal norms and attitudes and between personal values and attitudes, as shown in S3.

4.9 Summary

To sum up, despite there being only a few predictors of reuse behaviour, it is important to mention that it would be imprudent to expect a quick change in behaviour intention associated with reusing packaging. It is a significant task to examine how the public frames and to what they ascribe their behaviour regarding reusing packaging. The social behaviour aspects model was designed to investigate the most vital aspects that can lead

to increase reuse behaviour amongst societies through studying the interaction between all the aspects. This study found a direct connection between social norms and personal and social values if there is effort concentrated on developing the condition of packaging to be reused and how convenient reusing it is for the consumers. Therefore, a further chapter will be devoted to study what could promote reuse behaviour and explore how this could change social norms, personal attitudes, and others. This is achievable through exploring reusable packaging design attributes, which could encourage consumers to reuse packaging that satisfies their needs and help industry to identify people's orientation regarding packaging to be reused.

CHAPTER 5: Exploring reusable packaging attributes

5.1 Introduction

Environmental legislation refers to minimising environmental impact from packaging wherever appropriate, and recycling or reusing packaging in order to reduce the final disposal required by originations such as EU directives. A reduction in waste is recognised as a key contributor to countries' targets to achieve sustainability. Most packaging industries' sustainability tag becomes 'reduce, reuse, recycle' (Peattie and Shaw, 2007). Packaging is an important component of modern lifestyles. Different types of packaging play a vital role in production, preservation, distribution and marketing. Prendergast and Pitt (1996) have stated that the key trends in developing packaging based on the pressure to reach more environmentally friendly packaging are: convenience, functionality of packaging, logistics and environmental legislation, where convenience relates to such aspects as the ease of opening, re-closable packaging, ergonomic design, etc. Packaging functionality helps a product stand out in the market, such as attracting attention to a product and reinforcing a product's image. Logistics refers to the ease with which the packaging can be transported from manufacturer to end user.

Although the previous chapter showed that there is a good attitude among consumers towards the environment, especially in packaging, there is little packaging designed to be reused in order to control customers' behaviour. Therefore, this chapter investigates the reusable packaging attributes to encourage consumers and businesses to use reusable packaging as there is little evidence of investigation into consumer perceptions of reusable packaging. The chapter will focus on a reuse of packaging scheme through the life cycle of packaging in terms of producers and consumers. The chapter is based on consumers' experiences in reusing packaging and the experiences of experts from the industrial and academic sectors in designing packages. This chapter aims to promote reusable packaging amongst industries as a sustainable waste route option, alongside recycling and instead of disposal. Specifically, this chapter determines reusable packaging attributes that relate to consumers' requirements and motivations, which can assist industries during packaging design. This aim can lead to increasing environmental considerations amongst industries and reduce the environmental impact from waste packaging. The main objectives of this chapter are: (i) to study the relationship between

packaging attributes and reusable packaging through experts' opinion, and (ii) to verify reusable packaging attributes by conducting a qualitative study into packaging used for secondary uses.

5.2 Packaging attributes framework

This section of the research justifies the questionnaire items chosen to classify reusable packaging attributes. Many attributes have been identified based on an intensive literature review in order to identify suitable reusable packaging attributes. Previous research identified specific materials such as glass, plastic, cardboard and paper (Lofthouse *et al.*, 2009; Langley *et al.*, 2011), but in this research material has been considered as one attribute, such as material type, which provides a comprehensive perspective due to the importance of discovering general reusable attributes of materials. The material should be safe to use, sustainable, easy to handle, ergonomic and suitable for users. In addition, the Azzi *et al.* (2012) study considered safety of packaging as an independent criterion; however, in this research besides safety of packaging, ergonomics and sustainability will also be included. Moreover, Langley *et al.*'s study (2011) found that the consumers were concerned about the contents of packaging and the degree of cleanliness of the packaging from its contents. Whatever the packaging's contents are, if the packaging is easy to clean, then it can be reused. This means the packaging meets consumers' needs concerning its contents whereas the other study found that the packaging content had safety issues (Azzi *et al.*, 2012). The research presented here has considered the packaging contents under ergonomic aspects such as: ability to be cleaned, holding contents safely and hygiene. Moreover, Azzi *et al.*'s study considered material handling devices, traceability of information, and availability and transparency of information in terms of logistics (Azzi *et al.*, 2012); however, the current research excluded these attributes because they do not really describe packaging design attributes related to consumers but instead represent the logistics process.

From the general packaging attributes studies, the research included some attributes that are useful to consider during designing reusable packaging, such as accessibility of packaging for disabled users and elderly people, meeting consumers' requirements, post-consumer recycling after reuse, safe materials and instructions. This does not mean that the other attributes from general packaging attributes studies cannot be considered when designing reusable packaging but these attributes need more attention during

designing reusable product packaging and need some amendments to fulfil the reusable concept. Moreover, in this part the research only concentrated on attributes that attract people to use reusable packaging in various dimensions such as geometry/ergonomics, sustainability and marketing communication. The research did not investigate any attributes related to logistics or factors such as material handling devices, handling, lifting and loading activities in logistics, warehouses, stacking and stocking, filling, picking and sorting packaging, shipping, transportation and delivery, inventory control, traceability and transparency of information. Packaging capacity cannot be considered as one attribute, as the author observed during an intensive literature review that people reuse packaging of various dimensions, from small to large. Hence, this research identified 71 packaging attributes in the literature in various dimensions. These packaging attributes were assessed by the author on their relevance for considering re-usability during the design phase in terms of consumers' perspective, after which only 23 were found to be significant for further investigation through experts' opinion in various dimensions, as shown in Table 5-1. The next section will conduct an empirical study to develop and test the relationship between these packaging attributes and reusable packaging attributes.

Table 5-1: Packaging attributes from extant literature

	Attribute Derived from	Attribute	Sources
Geometry/ Ergonomics			
	Self-dispense packaging*	Refill ability with other product	(Langley *et al.*, 2011) ; (Lofthouse *et al.*, 2009) ; (Azzi *et al.*, 2012)*
	Packaging is easy to clean	Clean ability (content)	(Lofthouse *et al.*, 2009) ; (Langley *et al.*, 2011)
	Preservation of packaging	Hold content safety	(Langley *et al.*, 2011)
	Ease of restore	Restore ability	(Lofthouse *et al.*, 2009) ; (Azzi *et al.*, 2012)
	Ease of reseal	Re-seal ability	(Langley *et al.*, 2011)
	Convenient to open and re-close	Easy ability to open and re-close (quick to use)	(Lofthouse *et al.*, 2009)
	Durable	Endurance	(Langley *et al.*, 2011)
	Packaging format	Packaging characteristics	(Lofthouse *et al.*, 2009) ; (Azzi *et al.*, 2012)
	Dangers related to inappropriate packaging	Packaging mass and shape	(Lofthouse *et al.*, 2009)
	Packaging content had safety issues	Safe materials	(Langley *et al.*, 2011) ; (Azzi *et al.*, 2012)
Sustainability			
	Material characteristics and design	Packaging design and materials type	(Langley *et al.*, 2011) ; (Azzi *et al.*, 2012)
	Clear labelling on the packaging on how to deal with waste.	Environment communication (labels, instruction for post-consumer)	(Langley *et al.*, 2011) ; (Azzi *et al.*, 2012)
	Price incentive	Costs	(Lofthouse *et al.*, 2009) ; (Azzi *et al.*, 2012)
	Facilitating recycling activities	Post-consumer recycling	(Langley *et al.*, 2011) ; (Azzi *et al.*, 2012)
	Health care	Hygiene or easy to disinfected	(Azzi *et al.*, 2012)
	Recycling packaging	Recycling contents	(Azzi *et al.*, 2012)
	Less packaging or product waste and no mess	Less waste	(Langley *et al.*, 2011) ; (Azzi *et al.*, 2012)
	Accessibility of packaging for disabled users and elderly people	Meet consumers' needs	(Lofthouse *et al.*, 2009)

	Attribute Derived from	Attribute	Sources
Marketing and communication	Clear instructions and conveying information	Instructions (product and marketing information)	(Azzi *et al.*, 2012)
	Good quality of packaging and good value	Quality and value of packaging	(Lofthouse *et al.*, 2009) ; (Langley *et al.*, 2011)
	Concerns over how long refill will be available	Availability of support or services	(Azzi *et al.*, 2012)
	Perception of the higher value which is returned to the consumers	Incentives/rewards for use	(Lofthouse *et al.*, 2009)
	Increasing demand for more convenient packaging	Convenience to use	(Lofthouse *et al.*, 2009)

* The consumers take a reusable packaging back to store and then refill it with the same product.

* Reference (Azzi *et al.*, 2012) is a comprehensive framework on packing design.

5.3 An empirical study on the relationship between packaging design and reusable packaging attributes

Although there is much research about design packaging attributes and little research about reusable design packaging attributes, there is some prior research relating to the design of packaging attributes to reusable packaging. However, the European standard 'EN 13429:2004 reuse of packaging' (British Standards Institution, 2004) provides the requirements for packaging to be classified as reusable with sets of procedures assessing those requirements. The standard does not mention packaging attributes; rather, it is concerned with the general procedures for designing reusable packaging, which need to clarify what type of packaging attributes can fulfil these requirements. Also, the standard is old and there is no updated version published. In order to make the research manageable, reusable packaging attributes which were identified in the previous section need to be further investigated in terms of what the attributes must and should involve during packaging design. This section is going to develop and test packaging attributes in various categories related to reusable packaging. The chapter is going to conduct an empirical study by distributing a questionnaire among experts in the field of packaging design in industry and academia to determine reusable packaging design attributes.

5.3.1 Choosing the right experts in the packaging design field

During the research period of July to September 2013, the author contacted three experts in the field of packaging design and packaging optimisation within industry and academia. The experts' contact information was available via their published papers and in their personal profile on the Internet, which assisted direct contact with them during the case study. Three experts participated in the study; the first expert was a senior lecturer at Loughborough University in industrial design and has experience on how to involve designers in sustainability design, improving product performance in terms of environmental and social perspectives, improving packaging and developing innovative solutions. The expert has worked in many companies such as AB Electrolux, DCA Design International, Capital Standards, Giraffe Innovation/RSA, Practical Action, GlaxoSmithKline, Huntleigh, Acordis, Jaeger and Boots Company, across different departments such as print, packaging, interiors, textiles, consumer electronics, and medical. The second expert works as a senior research fellow. The expert has experience in applying technical and creative design methods in the health care sector, creative product design and interaction design. The expert's research is about

sustainable design in both society and the environment in order to reduce waste and influence consumers to reduce waste from products. The expert worked on the project Lab4Living. The third expert works as a research scientist in an industrial company and his area of research is optimal packaging and food products.

5.3.2 Questionnaire formulation and structure

The author designed the questionnaire to be a source for examining the reusable packaging attributes. The questionnaire was based on a multiple-item scale, which is more reliable than a single-item scale (Gliem and Gliem, 2003). The questionnaire design is based on a 5-point Likert scale (Binraman *et al.*, 2012) to analyse the extent to which reusable packaging attributes are important, in order to produce reusable packaging in various ways such as geometry, sustainability and marketing. The scale ranged from very unimportant to very important. The questionnaire has one section at the end for participants' comments. The questionnaire designed based on the content from the literature review which studied the packaging designed. The questionnaire constructed also based on how the previous studies had measured the variables from the experts' opinion. In the work presented here the ergonomic factors included the users' point of view relating to reusable packaging and it was measured by 10 questions about to what extent geometry/ergonomic attributes of packaging are important to produce reusable packaging. For sustainability, it included the social perspective only and eight questions were asked. In the marketing communication dimension, five questions were asked about to what extent marketing communication attributes on packaging are important when producing reusable packaging.

5.3.3 Questionnaire process and data collection

The questionnaire focuses on experts' experiences in the field of design packaging in industry and academia. It does not refer to specific packaging type, gender, age or country but is mainly concentrated on the experts in the field who have a good reputation in the field of packaging design, either academic or industrial. The questionnaire was piloted with people from both university and industry sectors and then refined before being sent to the experts. There were two academic from university and one engineer from the industry who refined the questionnaire. The pilot test contributed into to add more information about all the attributes which the participants going to assess in the beginning of the questionnaire. In addition, the pilot test donated

the importance of adding one section at the end of questionnaire to collect the participants' comments.

Questionnaire was designed by questionnaire designer website, which generated a link. The study used three experts. It is acknowledged that the low number of experts could result in a narrow breadth of opinion; however, this study is a preliminary study in the area of reusable packaging and could provide useful data and give the thoughts of the experts in the field of packaging design and packaging optimisation within industry and academia. The questionnaires were distributed via email to experts' personal email addresses, which were found in published papers and in their profiles during searching on the Internet. The author asked three experts if they had time to participate in the study during the period of time from September 2013 to October 2013. The questionnaire is presented in Appendix III. The data related to reusable packaging attributes were mainly extracted throughout the questionnaires and their analysis is presented in the next section of this chapter.

5.4 Statistical analysis

In this analysis section, experts' answers will be analysed by using normal average as Daim *et al.* (2013) found that a simple ranking of the criteria can provide similar aggregate weights to those obtained using the analytic hierarchy process (AHP) which measures the judgement of experts (Saaty, 2008). The questionnaire used the 5-point Likert scale, where 5 denoted 'very important' and 1 'very unimportant', as provided in Table 5-2. The 'very important' selection denotes that the attribute is essential and should be considered during designing reusable packaging. 'Important' selection indicates that the attribute is a supplemental attribute which augments the packaging. Possible attributes come from the 'neutral' indicator, which is important but may not be necessary during design.

Table 5-2: Normal Average expression

Average of criteria and sub-criteria	Indicator	Classification of reusable packaging attributes
0 to 1	Very unimportant	
1.1 to 2	Unimportant	
2.1 to 3	Neutral	Possible attributes
3.1 to 4	Important	Supplemental attributes
4.1 to 5	Very Important	Essential attributes

Figure 5-1 shows the weighting the experts gave to the importance of geometry, sustainability and marketing communication related to reusable packaging. The result from the experts shows that sustainability is an essential dimension for reusable packaging with the geometry/ergonomic dimension as an important indicator. However, the marketing communication dimension scores less. The author had a feeling that the sustainability dimension was going to come out as a first priority, as there were many references seeking to design sustainable packaging.

In the

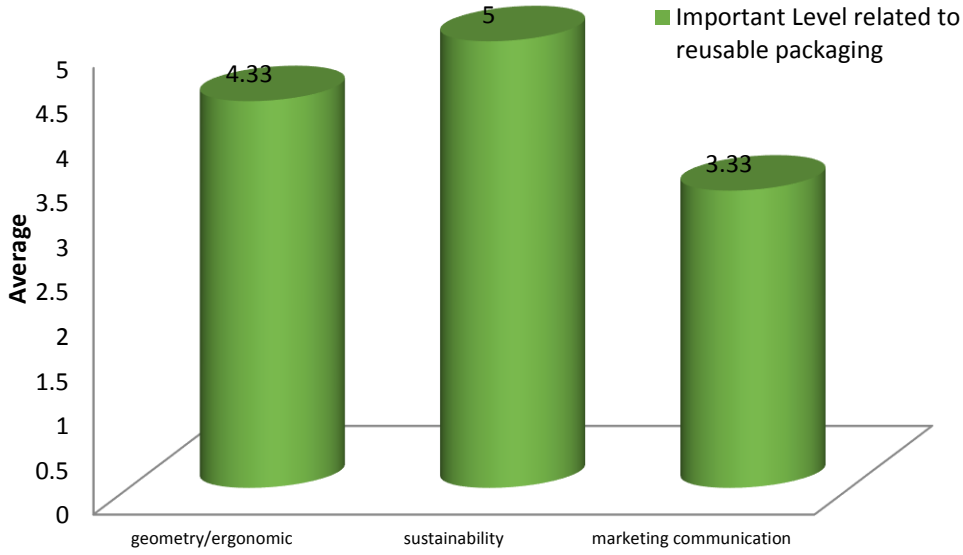


Figure 5-1**:** Main dimensions classification

geometry/ergonomic dimension, there are 10 attributes involved in the social group, as shown in Table 5-3. The averages of the experts' answers were calculated and are presented in Table 5-3. The results show that there are nine essential attributes that should be considered in order to design reusable packaging whereas there is one supplemental attribute.

Table 5-3: Average results of geometry/ergonomic attributes

Geometry/Ergonomic Attributes	Average	Classification

Refill ability with other product	5	Essential attribute
Clean ability (content)	5	Essential attribute
Re-store ability	4.33	Essential attribute
Re-seal ability	4.33	Essential attribute
Easy ability to open and re-close (quick to use)	4.33	Essential attribute
Packaging characteristics (weight, dimension and material, colour, print quality, size)	4	Supplemental attribute
Endurance	4.67	Essential attribute
Packaging mass and shape	4.67	Essential attribute
Hold content safety	5	Essential attribute
Safe materials	4.67	Essential attribute

In the sustainable dimension, there are seven attributes in three groups – the environment, economic and social – as shown in Table 5-4. The research only concentrated on how to implement sustainability of reusable packaging from the consumers' perspective. The averages of the experts' answers are presented in Table 5-4. As demonstrated in the results, all sustainable sub-criteria are significant attributes for designing reusable packaging. These results were expected due to the first results which showed that the sustainable dimension is the most important area one should consider when designing reusable packaging.

Table 5-4: Average results of sustainability attributes

Sustainable Attributes	Average	Classification
Packaging design and materials type	4.67	Essential attribute
Environment communication (labels, instruction for post-consumer)	4.67	Essential attribute
Costs	4.67	Essential attribute
Recycling contents	4.67	Essential attribute
Hygiene or easy to disinfected	4.67	Essential attribute
Meet consumers' needs	5	Essential attribute
Post-consumer recycling	4.67	Essential attribute
Less waste	4.67	Essential attribute

Finally, in the marketing communication dimension, there are five attributes that contribute to increasing reusable packaging sales, as shown in Table 5-5, which presents the averages of the experts' answers. The results reveal that there are four supplemental attributes for designing reusable packaging, while quality and value of packaging is an essential attribute.

Table 5-5: Average results of marketing communication attributes

Marketing Communication Attributes	Average	Classification

Instructions (product and marketing information and ways to reuse packaging)	3.67	Supplemental attribute
Quality and value of packaging	4.34	Essential attribute
Availability of support or services for reuse	4	Supplemental attribute
Incentives/rewards for use	3.67	Supplemental attribute
Convenience to use	4	Supplemental attribute

After the incentive literature review, the author found there is no research that determines what the reusable packaging attributes are. Then, the author decided to ask all the experts to what extent the packaging attributes, which are defined in Table 5-3, are related to the reusable packaging. The results were generated by calculating the average of the experts' answers as shown in Tables 5-5, 5-6 and 5-7. The results show that 23 packaging attributes are directly related to reusable packaging and they are classified into two groups: essential and supplemental attributes. There are 18 essential attributes as defined by the experts that must be considered during the design of reusable packaging, whereas there are five supplemental attributes, which could be included when producing reusable packaging as shown in Table 5-6 and Table 5-7. Furthermore, the research found that no previous studies have investigated reusable packaging attributes from the perspective of packaging used for secondary uses. Azzi *et al.* (2012), Lofthouse *et al.* (2009) and Langley *et al.* (2011) have all studied only the outlined packaging attributes from the primary packaging perspective which leaves the opportunity for further investigation, which will be addressed in the next section.

Table 5-6: Essential reusable packaging attributes

Dimensions	Attributes
Geometry/Ergonomics	Refill ability with other product Clean ability (content) Hold content safety Re-store ability Re-seal ability Easy ability to open and re-close (quick to use) Endurance Safe materials Packaging mass and shape
Sustainability	Packaging design and materials type. Environment communication (labels, instruction for post-consumer). Costs Post-consumer recycling Hygiene or easy to disinfected Meet consumers' needs Recycling contents Less waste
Marketing and communication	Quality and value of packaging

Table 5-7: Supplemental reusable packaging attributes

Dimensions	Attributes

Geometry/Ergonomics	Packaging characteristic (weight, dimension and material, colour, print quality, size)
Marketing and communication	Instructions (product and marketing information)
	Availability of support or services
	Incentives/rewards for use
	Convenience to use

5.5 An empirical study on the relationship between packaging used for secondary uses and reusable packaging

During comprehensive research of packaging attributes, the author found that there are a number of consumers who reuse packaging for other uses. There is no previous research that investigates these types of packaging attributes, which is a vital step to identify some of the attributes of reusable packaging. This step desires to identify reusable packaging attributes and avoid the confusion of reusable packaging attributes for main purposes or for secondary purposes. This step intends to highlight the real case of reuse behaviour with product packaging and to understand the attributes that convince consumers to reuse product packaging. The research will pick the participants' experiences carefully and analyse them to identify reusable packaging attributes. There are many different kinds of packaging that have been recognised for reuse for other purposes in people's lifestyles. A qualitative study was conducted by another questionnaire, which consisted of three questions: product packaging name, what the packaging was reused for and why this packaging was reused, and, finally, the questionnaire asked respondents to attach photographs of reusable packaging, as appended in Appendices III and IV. The questionnaire does not keep specific packaging types; rather, it gives open choices for answers to questions with any type of packaging that the respondents reused. This questionnaire was designed to be deployed over the Internet. All textual data that come from participants are in electronic form. This questionnaire allowed participants to enter two types of product packaging that they reuse and also allowed participants to repeat the questionnaire if they had packaging from more than two products by clicking on the questionnaire link again. The questionnaire was piloted with three participants and then refined before the questionnaire link was diffused through various modern ways during the time period of July 2013 and August 2013.

Thus, the questionnaire link was sent to volunteers by various modern ways. The ways that the author distributed the questionnaires were posting on social networks like

Facebook, Twitter and advertising on some websites. In turn, those participants were asked to forward the questionnaire link to other people. The questionnaire strategy used a snowball sampling concept, 'who-knows-who', which asks participants who else should be participating (Malhotra and Birks 2006). In order to assess the presence of non-response bias, the assumption is that respondents who have the same types of answer were excluded for analysis as it is not going to add any value; however, they are accounted in as the number of participants in order to find out the rate of response. The recent contemporary experimental methods used the image as a part of study was Langley *et al.*'s (2011) study, which used questionnaires in order to identify product packaging that falls into the various categories but the study included some product images under various dimensions for testing consumers' behaviour towards various packaging. The questionnaire in the current study has the advantage of not focusing participants' attention on a specific area of social behaviour. The results from participants are closer to individuals' real behaviour, which makes the objectivity of participants and interpretation of results more valuable and avoids people's imagination. The imagination behaviours come from some questionnaires which direct participants' intention as opposed to their real behaviour. Questionnaires were sent to 250 households, of which 100 returned the questionnaire; however, only 50 of these were fully completed – the others were rejected. The response rate was 20%. The participants received a plain language statement, which explained the research aim and objectives, with the questionnaire link. The plain language statement is provided in Appendix IV and V. The reusable packaging photographed by participants was of 25 types and each one was given a descriptive name, a brief description of features that have to be reusable, and an image of packaging which will be easy to identify during further investigation. The 25 kinds of packaging reused for secondary uses are outlined in Appendix VI.

5.5.1 Refining secondary packaging reuse

In order to make the test manageable, it is important to reduce the amount of packaging mentioned in the questionnaire to conform to a reasonable timescale. In the Lofthouse *et al.* study (2009) about refillable packaging, there was some refillable packaging that was rejected for further investigation because it was inconvenient for consumers and business or did not fit into the business model. Therefore, the research discounted those types of packaging that have the same functions. Table 5-8 provides a summary of

packaging which has been considered as one type for further analysis and reasons for this consideration.

Table 5-8: Reusable packaging rejected for further analysis

Type	Packaging name	Reason for consideration as one packaging example
Glass	Olive bottle, Honey pot, Yogurt bottle, Jam bottle, Apricot Jam, Cheese bottle and Gram bottle	All these types of bottle packaging are considered as one example because they have the same function to re-store items in glass packaging.
Carton	Indonesian noodles box, Mobile box, Toy gift box, Pure DKNY perfume box, Sony Ericsson phone box, Delivery box, Clarks shoe box, Cotton buds and Guess Wristlet bag box	All these types of box packaging are considered as one example because they have the same function to re-store items in carton packaging.
Plastic	Sony Ericsson phone box, Olay Creams and Coffee whitener	All these types of packaging are considered as one example because they have the same function to re-store items in plastic packaging.
Steel	Quality Street box, Baby milk box	These two box packaging items are considered as one example because they have the same function to re-store items in steel packaging

The reusable packaging, on which the research will concentrate, comprises glass, steel, plastic and carton packaging. These classifications of packaging were used to facilitate further investigation. For understanding a person's reason behind their reuse of packaging, the particular question of why they reused this packaging for other purposes is essential. All the answers provided are shown in Table 5-9 and the research has excluded repeated answers.

Table 5-9: Positive attitudes towards reuse of packaging

POSITIVE ATTITUDES TOWARDS REUSE OF PACKAGING
Better organised
Strong plastic protects the jewellery from scratching
Cleaner to hold them (Dry)
Tidy, and helps me find them faster when they are in one place
Very tidy in case I lose them
It is very good preventing air and light from reaching the chemicals and avoids oxidation
It is just convenient and perfect size
Very good quality box, convenient too to carry around
Prevents it from getting dusty
Cheap and keeps them fresh
Clean to reuse and can be easily disinfected
Keeps them fresh
Good quality, easy to reuse
Keep sauce fresh & easy to reuse
Good quality
Easy to use and good quality
Good quality and less waste
Free, easy use, protect environment from global worming

Qualitative data analysis was then carried out using 'codes and coding', which are common analyses that define meaning from participants' words and build theory from

data (Miles and Huberman, 1994). For example, Lofthouse *et al.* (2009) carried out coding and clustering to analyse qualitative data about refillable packaging. The 'coding and clustering' approach helps the qualitative researchers to analyse data easily when there are a number of answers from participants. There are a variety of terms to talk about codes and coding such as 'index', 'themes' and 'category' (Gibbs, 2008). The structured list of codes identifies what codes the answers represent in a way that is special for packaging attributes and not purely descriptive. It involves carefully reading participants' answers and describes what types of attributes are behind the answers. The advantages of coding are to help researchers to apply the code in a consistent way during further investigation. Table 5-10 illustrates the coding of participants' answers in terms of why they reuse packaging and relate the code to the categorical level.

Table 5-10: Coding and categorisation of participants' answers

Participants' answers about the reasons for reuse of packaging	**Coding**	**Categorisation**
Better organised	Easy ability and convenience	Geometry/ ergonomic attribute
Strong plastic protects the jewellery from scratching	Endurance	Geometry/ ergonomic attribute
Cleaner to hold stuff (Dry)	Dry packaging	Content
Tidy, and helps me find them faster when they are in one place	Easy ability	Geometry/ ergonomic attribute
Very tidy in case I lose them	Easy ability and convenience	Geometry/ ergonomic attribute
It is very good preventing air and light from reaching the chemicals and avoids oxidation	Hygiene	Geometry/ ergonomic attribute
It is just convenient and perfect size	Size and convenience.	Geometry/ ergonomic attribute
Very good quality box, convenient too to carry around	Quality, Portability and convenience	Geometry/ ergonomic and marketing communication attributes
Prevents it from getting dusty	Refill ability and re-store ability	Geometry/ ergonomic attribute
Cheap and keeps them fresh	Rewards for use	Marketing communication attribute
Clean to reuse and can be easily disinfected	Clean ability and easy to disinfected	Geometry/ ergonomic attribute
Keeps them fresh	Refill ability and Re-store ability	Geometry/ ergonomic attribute
Good quality, easy to reuse	Quality and convenience	Geometry/ ergonomic and marketing communication attributes
Keep sauce fresh & easy to reuse	Refill ability, re-store ability and easy ability	Geometry/ ergonomic attribute
Good quality	Quality	Marketing communication attribute
Easy to use and good quality	Quality and convenience	Geometry/ ergonomic and marketing communication attributes
Good quality and less waste	Quality and environmentally	Marketing communication and sustainable attributes
Free, easy use, protect environment from global worming	Rewards for use, easy ability and environmentally	Marketing communication, geometry/ ergonomic and sustainable attribute

5.5.2 Analysing packaging attributes from packaging used for secondary uses related to reusable packaging

The analysis of the questionnaire does not discriminate among packaging types but considers all types of packaging from consumers. The results from the investigation into packaging used for secondary uses provide the main attributes that consumers seek when reusing packaging. The results of the attributes interpreted into physical and non-physical packaging attributes. From Table 5-10, it can be seen that attributes of packaging that encourage people to reuse are for different purposes. It concentrates mostly on physical attributes such as geometry of packaging, the quality of packaging materials and the content of packaging. Hence, the results show that consumers who reused packaging did not have any concerns regarding whether or not the packaging material had any influence on health issues. This reflects that users have high confidence in the packaging materials that the manufacturer has used and believe that there is not any risk to health and safety. In addition, the results of this study show that there are a high number of participants who reuse glass packaging because of its reusable quality. Furthermore, during analysis of the questionnaire, from packaging used for secondary uses, packaging that can be refilled and is also easy to reclose and reopen is more likely to be reused. Moreover, packaging of a sensible size is seen to be more worthwhile for the practice than small packaging, which most consumers are likely to discard as waste. The results from the questionnaire on packaging used for secondary uses show that portability of packaging which converges with its size and dimension can lead to ease of carrying and storing. This result from the questionnaire indicated that packaging size formats have obvious potential for encouraging reuse. Therefore, some packaging attributes can encourage users to reuse the packaging at the end of its life. This kind of user perception, on which packaging attributes have been built, can move the waste away from being seen as disposable in consumers' minds to one of the most sustainable waste route options like reuse.

However, in the non-physical packaging attributes, there is little difference in the results, and only a few attributes observed from the questionnaire due to the nature of the questionnaire did not focus participants' attention on a specific area of social behaviour. The results from participants who reuse packaging for secondary purposes show that they are not concerned about the print quality and colour types. Also, the original price of packaging had a variety of results. The participants who reuse packaging for

secondary uses are not concerned about the price of the packaging as they always said it is ‘free’ to get the value from re-using the packaging. Another factor, availability of services, is one of the factors that most sustainable waste options are concerned about; however, in the reuse option, the situation is different. The results show that participants who reuse packaging for secondary purposes were not concerned about whether the packaging could be refilled with the same contents, which means that as long as the packaging has features to allow it to be reused, it is enough. A reward for reusing packaging for its primary purpose is another non-physical attribute which most consumers are looking for. However, reusing packaging for secondary purposes comes from the consumer her/himself and how they can get value from reusing this type of packaging. Reuse is an approach that requires forward planning, which means that, when purchasing the product, the consumer has for some time planned to reuse the packaging for secondary uses. Thus, the reuse activity for secondary uses is not normative – unlike reuse for the same purpose, which requires availability of refills. There are few answers amongst participants about how reuse of packaging for secondary uses is due to concern about the environment. In summary, the results from the questionnaire from packaging used for secondary uses indicate that there are 13 essential packaging attributes, which verifies most of the reusable packaging attributes, as shown in Table 5-11. Moreover, most of the 13 essential packaging attributes for packaging reuse for secondary uses come from an integrated approach and an empirical study except the portability of packaging, which did not appear in prior analysis. This result confirms that there are no different reusable packaging attributes between packaging reuse for the same purposes and reuse for secondary uses. In other words, packaging attributes are the behaviour control for reuse of packaging like availability of recycling bins in recycling activities. This is because of the functionality of these attributes which allow the packaging to be reused. Finally, packaging that has no obvious reuse function is likely to be discarded as waste.

Table 5-11: Reusable Packaging Attributes for Secondary uses

Marketing communication	**Geometry**	**Content**	**Sustainable**
Quality	Refill ability with other stuff	Dry	Environmentally
Convenience	Clean ability	Wet	
	Portability		
	Re-store ability		
	Endurance		
	Size		
	Easy ability		
	Hygiene or easy to disinfected		

Comprehensive research was undertaken between packaging design attributes and reusable packaging in an attempt to determine a set of common attributes, which include dimensions such as sustainability, geometry/ergonomic, marketing and communication. The range of reusable packaging attributes is shown in Table 5-12 from the results in Table 5-6, 5-7 and 5-11.

Table 5-12: Reusable packaging attributes after combining the results of the relationship between packaging design and reusable packaging, and the relationship between packaging used for secondary uses and reusable packaging

Geometry/Ergonomics	Sustainability	Marketing communication
Refill ability with other product	Packaging design and materials type	Instructions (product and marketing information)
Clean ability (content)	Environment communication (labels, instruction for post-consumer)	Quality and value of packaging
Hold content safety	Costs	Availability of support or services
Re-store ability	Post-consumer recycling	Incentives/rewards for use
Re-seal ability	Hygiene or easy to disinfect	Convenience to use
Easy ability to open and re-close (quick to use)	Meet consumers' needs	
Endurance	Recycling contents	
Packaging characteristics (weight, dimension and material, colour, print quality, size)	Less waste	
Packaging mass and shape		
Safe materials		
Portability		

5.6 Description of reusable packaging attributes

This chapter provides results relating to various dimensions of the reusable packaging attributes. In order to better understand about reusable packaging attributes, this section will explain the attributes for each dimension separately. Tables 5-13 explains the dimensions for the geometry/ergonomic attributes.

Table 5-13: Geometry/Ergonomic packaging attributes' explanation

Clean ability	Reusable packaging should have the ability to be easily cleaned without leaving any odour or residue. The process of removing contents should not damage or injure users. Also, the process of cleaning should consider users who may have disabilities or are elderly.
Portability	Packaging that need less effort to carry and handle is likely to be more desirable to reuse. Designers of reusable packaging should work out the optimum weight for easy carrying and handling. The reusable packaging should also consider users who may have disabilities or are elderly.
Re-store ability	Packaging that takes up less space may encourage better use. Designers of reusable packaging should form packaging to an optimum size in order to facilitate packaging that can be reused for storage. The reusable packaging should also consider users who may have disabilities or are elderly.
Re-seal ability	Packaging that can be re-sealed is more likely to be reused due to preservation of the contents.
Refill ability	This means packaging that has the ability to be refilled with the same product. Also, refill ability means the packaging has the ability to store anything that consumers' desire such as food, clothes, jewellery, etc.
Easy to open and close	The ease of opening and closing of the packaging for a number of applications is one attractive attribute of reusable packaging. Design of reusable packaging should ensure that opening and closing systems are convenient and commensurate for all people, even for users who may have disabilities or are elderly people. If the opening or closing method is not obvious, clear instructions should be provided.
Endurance	Packaging with sufficient strength to protect contents and secure them during storage is also a preferable attribute in packaging in order to reuse it. Designers should design reusable packaging that provides adequate strength against predictable shocks and provides necessary resistance to reuse packaging several times. The strength function can be important in various dimensions such as sales, transportation and during users' practices.
Packaging characteristics	In reusable packaging, the packaging characteristics, on which the research concentrates, include colour and print quality on packaging, which should attract consumers at the point of sale.
Packaging handle shape	Packaging that has a safe shape during movement, carrying and handling has more satisfaction for consumers during reuse. Designers of reusable packaging should design reusable packaging with a draft angle (it means the angle in any shape should be bent) to avoid sharp edges.
Hold contents safety	The concept of packaging is to contain the contents safely. Also, reusable packaging should hold the contents safely for multi-uses.
Safe materials	The reusable packaging material must be hygienic and not contaminate the users during utilisation or the environment during disposal or recovery.

The primary roles of packaging are to contain, protect and present the product. It is important to integrate ergonomic aspects in reusable packaging. Reusable packaging always requires different types of activities such as handling, lifting, cleaning, endurance, etc. These activities can result in injuries or feeling of inconvenience. Thus, reusable packaging needs to be designed to meet ergonomic requirements and optimal packaging performance to satisfy consumers' uses (Rosenau, 1996). To fulfil this function, reusable packaging should have sustainable attributes. Sustainable attributes means that the packaging design team has to address the balance of sustainability attributes in the packaging design through use of raw materials, energy, etc. Thus, reusable packaging needs to be designed to be sustainable. Reusable packaging should have the sustainable attributes listed in Table 5-14.

Table 5-14: Sustainable attributes' explanation

Environmental communication	Reusable packaging should guide consumers on how to reuse it and the instruction should be in plain language. Designers of reusable packaging should consider the best place to present clear and easy information about how to reuse packaging in an environmental manner. This information assists the consumers to choose the correct recovery options such as recycling, reusing, composting, etc.
Costs	Reusable packaging needs to be at a reasonable price and show the user how his/her participation could save their further expense.
Hygienic and Easy to disinfect	Packaging that is hygienic and easy to disinfect should give consumers the ability to clean the contents without any health problems or contamination of the contents.
Post-consumer recycling	Reusable packaging with further post-consumer recycling should be considered in order to reduce environmental impact. Designers of reusable packaging should include a small symbol to identify that the packaging material can be recycled with clear information that the recycling can be done after reusing. Therefore, the consumer can put the packaging into the appropriate recovery collection.
Meet consumers' needs	Reusable packaging that meets consumers' orientations has positive effects on society, encouraging participation in reuse activities.
Packaging design and materials type	Reusable packaging needs innovative design in order to make the packaging reusable. There are various types of packaging materials that are designed to be reusable such as glass, metal, plastic and cardboard.
Recycling contents	Reusable packaging needs to be designed with recyclable contents in order to provide the consumers with options for post-consumer recycling and avoid throwing packaging into bins.
Less waste	Reusable packaging leads to less waste. Designers should consider less waste generation during the design of reusable packaging.

Reusable packaging needs to be designed to communicate with consumers in the market and attract them to purchase reusable packaging. Thus, reusable packaging needs to be designed to include marketing communication. The reusable packaging should have the attributes listed in Table 5-15.

Table 5-15: Marketing communication attributes' explanation

Quality and value of packaging	The quality of packaging consists of various dimensions such as material types, packaging life through reasonably anticipated lifespan and strength against puncturing, scratching and abrasion.
Availability of support or services	The support for reusable packaging comes from the services provided to consumers such as refill machines and refurbishment or cleaning of the packaging.
Incentives/rewards for reuse	Reusable packaging should effectively communicate with users in order to encourage them to decide to buy reusable packaging, illustrating the rewards that come from saving money and helping to conserve the environment.
Convenience of use	Any reusable packaging should be convenient to be reused. It means that it includes important functions, which make the packaging suitable to be reused such as shapes which meet culture habits or the way it presents its packaging consistent with a particular culture.

5.7 Reusable packaging attributes checklist

Comprehensive research was undertaken between packaging design attributes and reusable packaging in an attempt to determine a set of common indicators which include dimensions such as sustainability, geometry/ergonomic and marketing communication. These indicators help companies identify the capability of packing to be reused and help the designer respond creatively and effectively to expand the scope and ambition of thinking. Since the reusable packaging attributes provide a comprehensive palette of indicators that address the breadth of the reusable packaging system, not all of the attributes are relevant for all types of packaging. Therefore, manufacturers and designers should consider those attributes that are most relevant to their goals and objectives. The research presented in this thesis generated a checklist which yielded a list of 23 attributes, as shown in Figure 5-2. The set of 18 essential and set of five supplemental attributes are refined by experts' experiences. The proposed reusable packaging checklist includes a number of environmental, social and economic attributes for which there are no life cycle assessment standards/protocols.

Reusable packaging attributes checklist

Product's packaging name: Company name:

	Meet	Not Meet	Not related
Essential reusable packaging attributes			
Refill ability with other product			
Clean ability (content)			
Hold content safety			
Re-store ability			
Re-seal ability			
Easy ability to open and re-close (quick to use)			
Endurance			
Packaging mass and shape			
Safe materials			
Portability			
Packaging design and materials type			
Environment communication (labels, instruction for post-consumer)			
Costs			
Post-consumer recycling			
Hygiene or easy to disinfect			
Meet consumers' needs			
Recycling contents			
Less waste			
Quality and value of packaging			
Optional reusable packaging attributes			
Packaging characteristics (weight, dimension and material, colour, print quality, size)			
Instructions (product and marketing information)			
Availability of support or services			
Incentives/rewards for use			
Convenience to use			

Figure 5-2: Reusable packaging attributes checklist

5.8 Discussion

Any company that intends to convert one-way packaging to reusable packaging should begin to develop packaging by focusing on only one dimension and then seek to address additional dimensions as the design process progresses. Alternatively, the company may choose to begin by using a core attribute from each dimension. In addition, during the packaging design process the boundary and scope are essential to determine what the company can include or cannot include based on its goals.

The study's results from investigating packaging used for secondary uses are similar to those from previous research on reusable packaging. For physical packaging attributes, this study indicates that there is no particular concern amongst consumers who reused packaging about the type of material used, as long as the packaging is easy to clean and reuse. These results are conclusively shown by Lofthouse *et al.* (2009), who found that consumers are looking for easy to clean packaging and will then refill it. For hygienic or

easy to disinfect aspects, the results show that participants had no any concern about whether or not the packaging material has any influence on their health during cleaning the packaging. This result is consistent with the study conducted by Jetten (1999), which investigated the quality and safety of reusable food packaging. They found that there is no significant influence on chemical or physical quality by rewashing and reusing packaging; however, in some instances there is flavour carry-over or off-flavours to new filling materials.

Also, results from the questionnaire together with the previous research results reflect the importance of how easy it is to open and re-close the packaging during use, as Lange and Wyser (2003) stated. In addition, Langley *et al.*'s (2011) study found that glass packaging is reused more than any other type of packaging material due to the perception of high value and its potential for reuse. Also, they found the reuse of metal and plastic packaging is rare because its contents tend to leave a residue, which makes it difficult to clean these types of packaging and so increases the chance that they contain some health and safety risks. These results are consistent with the results of this study which highlighted the importance of the quality of the reusable packaging in order to encourage reusable packaging practices. Furthermore, re-sealable ability is shown to be one of the essential attributes amongst consumers' answers and experts' evaluation. Likewise, other studies reiterate this, such as Langley *et al.* (2011) and Wever *et al.* (2010), who found that re-sealable packaging is more likely to be reused than recycled. In packaging characteristics, the result shows how packaging size can also encourage the consumers to reuse their packaging and this result is consistent with other studies (Lofthouse *et al.*, 2009; Langley *et al.*, 2011) which indicated that packaging size formats have obvious potential for reuse. This is because of the strength of large containers compared to small ones.

For non-physical packaging attributes, there appears to be little difference in the results between packaging used for the same purpose and packaging used for secondary uses. For packaging characteristics such as colour, Rundh (2009) stated that the original colour and print quality of the packaging have high meaning for people, but for secondary uses this is not essential. With regard to the price of packaging, Lofthouse *et al.* (2009) found that participants who reused packaging for the same purpose endeavoured to refill both the cheapest and the highest-quality packaging, but for secondary uses there is no such concern. In reusing packaging for the same purpose

there is always concern about the availability of refills, but for secondary uses of packaging that was less important as packaging functionality was more important. In incentives/rewards for use, participants who reuse packaging for the same purpose demand a reduction of price for reusing the packaging, whereas for secondary uses of packaging the value is in the actual reuse of the packaging.

According to the European standard 'BS En 13429:2004 reuse of packaging' (British Standards Institution, 2004), there are four main requirements placed on any packaging on the market classified as reusable. The first requirement concerns packaging design, such that the packaging must confirm that it is capable of reuse in normally predictable conditions of use. The appropriate attributes that meet this requirement, which the reusable packaging attributes model mentions, are refill ability, clean ability, portability, re-store ability, re-seal ability, packaging characteristics, endurance, holding contents safely, packaging mass and shape, and packaging handle shape. The second and third requirements talk about tertiary packaging, which is packaging for transport purposes. The research excluded this type of packaging from the investigation due to lack of resources and difficulty in obtaining data from logistics.

The fourth requirement addresses the reconditioning system of packaging. This requirement consists of various procedures that assess packaging design, environmental impact and ergonomic aspects. In this paragraph, the research will discuss the first procedure, which focuses on particular circumstances in which reuse occurs. It means the manufacturer/designer should determine the way in which the packaging can be reused. This is an important task during the manufacture of reusable packaging where consumers can understand how to reuse the packaging in an appropriate way. In the reusable packaging attributes checklist, especially under the sustainable dimension and marketing communication, the checklist identified some attributes that can help achieve this procedure. These attributes are communication of environmental requirements, which involves labels and instruction for post-consumer usage, and instructions attribute (product and marketing information and ways to reuse packaging), which can provide detailed information on the way to reuse packaging. The second procedure concerns the environmental impact of packaging. In the reusable packaging attributes checklist, especially under the sustainable dimension, the checklist identified four core attributes focusing on the environment: packaging materials, post-consumer recycling, hygiene and recycling contents where the packaging can be eco-friendly. The third procedure is

about the ability of packaging components to accomplish a number of trips under normal conditions. In the reusable packaging attributes checklist, especially under the ergonomic dimension, the proposed checklist identified the importance of packaging having the endurance attribute during the production of reusable packaging.

In this paragraph, the research will continue to explain how the reusable packaging checklist can explain the rest of the procedures. The fourth procedure is about emptying/unloading packaging without significant damage. In the reusable packaging attributes checklist, especially under the ergonomic dimension, the checklist identified some attributes that the designer/manufacturer can implement to meet the requirement of avoiding damage during emptying the packaging. These attributes are endurance and packaging mass and shape, which are classified as core attributes in the manufacturing perspective. The fifth procedure highlights the essential need of packaging to meet the packaging purpose; in other words, the packaging should not lose its purpose of presenting the product or preserving product contents. For instance, product loss, damage and spoilage will result in materials and energy loss, losing social credit and impact on the environment. The sixth procedure highlights the importance of packaging during refill/reload to be safe for health during reuse. In the proposed reusable packaging attributes checklist, especially under the ergonomic and sustainability dimensions, the checklist clarifies some attributes that contribute to satisfy this procedure. These attributes are that packaging can safely hold the contents, uses safe materials, and is hygienic or easy to disinfect and clean. The seventh procedure emphasises the role for markets to support the reuse system. This is achievable by providing refilling stations in stores to facilitate the process for people, which is under the availability of support and services attribute.

5.9 Implementation of the reusable packaging checklist

The feasibility of the design phase is to show all of the components of the design and the way to identify problems and solutions in order to improve and develop the design so that designers can encourage one-way packaging to become reused through the results from this chapter. The main advantage of the results in this chapter is to provide a guideline for the manufacturer/designer who intends to design reusable packaging. The proposed checklist identifies the opportunities for improving packaging to meet a sustainable profile and be reusable at the same time. The proposed checklist is a

resource that can help companies better understand how they can convert their normal packaging or one-time packaging to be reusable packaging. The results can help designers/manufacturers in the early phases of packaging design to interpret the reuse of packaging requirements and procedures presented in 'BS En 13429:2004 reuse of packaging'. Companies who seek to improve packaging sustainability performance, such as carton companies and beverage companies, can use the results from this chapter to do so.

5.10 Summary

To sum up, the study has conducted intensive research through the combination of quantitative and qualitative methods in order to investigate attributes related to reusable packaging. The work has generated a reusable packaging attributes checklist which consists of 23 attributes in various dimensions such as geometry/ergonomics, sustainability, marketing and communication. Of the 23 attributes, there are 18 essential attributes and five supplemental attributes. These attributes are defined in relation to consumers' orientation. In addition, these attributes contributed to interpreting the reuse of packaging standard requirements and procedures under various dimensions. The outcomes from the study are to influence industry to consider reusable packaging during production after identifying consumers' orientation. This proposed checklist facilitates, for manufacturers and businesses, an understanding of how to meet the reusable packaging requirements and procedures. This study found that the reusable packaging attributes checklist can be set as a guideline for the manufacturer/designer during the design phases. The reusable packaging attributes checklist could not enhance the reusable packaging in industry totally, but the concern could be raised amongst manufacturers about whether reusable packaging results in environmental benefits – not only in reduction of waste packaging but in other dimensions such as conservation of energy resources, reduction of raw materials, etc. – or instead costly burdens for the environment and firms. This concern comes from government interventions to reduce the amount of packaging specifically and whole waste in general through setting up new regulations. Hence, this leads the research to a further chapter which will be devoted to discovering the environmental impact of reusable packaging attributes. This is achievable through investigating empirically the relationship between reusable packaging's attributes and its environmental impact.

CHAPTER 6: Analysis study of environmental impact of reusable packaging attributes in the Packaging Industry

6.1 Introduction

The economic value of implementing an ecological system is an important topic as well amongst industries. This can create new value to the industries if benefit is returned to the company, such as that from recycling which can produce new production from unused outputs; as Ceppa and Marino (2012) found, reuse of output can lead to less use of raw materials, increased use of resources that are already on site and a high quality finished product. The economic factors are the primary motivator which encourages most industries to drive environmental initiatives, according to Rao (2005; 2007). On the other hand, Grimes-Casey *et al.* (2007) suggested that if any company is aware that other companies are trying to reduce their environmental impact, it might encourage the company to take alternative actions to meet the required standard.

The improvement of environmental performance within firms gives the opportunity to lower costs and develop more efficient technologies. Improved environmental performance can also generate increasing revenues through the development of new products or through the delivery of more products to environmentally sensitive customers. Many industries are looking at embodying environmental initiatives through their products in order to gain financial benefits. The fundamental motivation within industries is to operate an ecological system so that firms can improve their environmental credentials through integrating products to find a symbiotic relationship which reduces environmental impact and improves the firm's efficiency. Also, firms can improve their corporate reputation and legitimacy through product quality and quality perceptions.

Designing reusable packaging can be considered as one of the environmental initiatives within the industry. Most firms have environmental concerns due to potential cost savings or risk avoidance or they are forced by government policy and legislation to implement ecological programmes. In addition, the lack of knowledge in existing studies that examine the environmental impacts of reusable packaging restricts the production of reusable packaging in the production line. In this chapter, the effect of reusable packaging attributes will be empirically investigated during the production stage on environmental impact in order to set a theory from this investigation.

The main aim of this chapter is to attempt to bridge the gap in the literature to investigate the environmental impact of reusable packaging attributes in a systematic manner, and to inform governments' policy on the environmental impacts of reusable packaging in order to enhance/restrict reusable packaging. The chapter's objectives to address the relationship between implementing reusable packaging attributes in existing packaging are: (1) designing a general framework that links reusable packaging attributes with environmental impact indicators through an integrated approach of extant literature and (2) evaluating implementing reusable packaging attributes through experts' opinion on environmental impact and packaging. Therefore, more empirical research about the relationship between reusable packaging attributes and environmental impact would be helpful in order to get a broader picture of the current status of reusable packaging with the environment and explore the further environment initiatives in implementing the reusable packaging attributes.

6.2 Environmental impact framework

It is essential to define the study boundary and framework of environmental impact within reusable packaging attributes in order to conduct the research logically. The main advantage of defining the study boundary and framework is to ensure that all environmental entries for reusable packaging are included properly for investigation and allow for comparison with other type of reusable packaging for further improvement. There are several different aspects of environmental effect from the extant literature. It is not feasible to include all of them; it would make the results incomprehensible. As shown in the literature review, the research identified a variety of successful indicators that are inherent to exploring the environmental impact for production, business and even countries. These indicators include the various dimensions on environmental impact and are concentrating on the amount of waste generated and the amount of the resources used. The research will focus on the reusable packaging itself and its impact on the environment. In addition, the research is going to investigate two main dimensions in the environmental impact: (1) environmental condition of implementing reusable packaging from manufacture, and (2) global condition of implementing reusable packaging. The main reasons for dividing environmental impact indicators into two groups are:

- First, ISO14031, SAFE and ESI models note the importance of assessing the ecological effect through one main category with various names.

- Second, the ESI model gives the essential indicator for considering the global effect as a separate category in order to distinguish the influence of producing and global effect as ESI considered global stewardship as independent indices to assess the environmental impact.

This chapter will not use some types of indicators for further investigation, such as loss of biodiversity, human health effects, eco-toxicity, ozone layer, effect on landscape, noise and vibration, radiation and waste heat. They are not considered within this study because of the difficulty to link them with the reusable packaging, as this chapter does not specify type of packaging for investigation but rather is going to find out the general effect of reusable packaging on the environment. Moreover, this chapter will not test the firms' environmental performance in compliance, product & services, transportation and overall performance. This chapter focuses only on the condition of reusable packaging attributes in terms of resources and waste and global effects. Therefore, this chapter is going to investigate the environmental impact indicators only with regard to their relationship to reusable packaging attributes, as shown in Table 6-1, through exposure to the experiences of experts from academia and industry regarding the environmental impact of packaging. The author has chosen to include all the reusable packaging attributes and investigate their effect on 19 environmental impact indicators, as shown in Appendix VII.

Table 6-1: Environmental impact indicators' framework

Environmental condition	Resources	Primary energy Net energy Fossil fuel consumption Oil and gas use Electrical use Raw material use	
	Waste	Emissions	Photochemical oxidants Acidification Eutrophication Air pollution CO_2 emissions
		Solid waste	Toxic wastes Hazardous wastes
		Water waste	Water quality Water quantity Effluents
Global condition	Global warming Greenhouse gas emissions Climate change		

6.3 An empirical study of the relationship between reusable packaging attributes and environmental impact factors

As shown in the literature review, some of the previous studies investigated the environmental impact of packaging, such as assessing packaging performance with its environmental impact, environmental impact of packaging material and environmental impact of new packaging design. However, this chapter is going to investigate the environmental impact of reusable packaging attributes, where there is no extant research. The chapter is going to conduct an empirical study by distributing a questionnaire among experts in industry and academia in the fields of environmental impact, sustainable packaging, packaging design and green packaging to determine the environmental impact of reusable packaging attributes.

6.3.1 Choosing the right experts in the environmental impact field

During the research period of March to April 2014, the author contacted many experts in the field of environmental impact, sustainable packaging, packaging design and green packaging within industry and academia. The experts' contact information was available via their published papers. The other experts have been visited and questioned via the questionnaire. There are nine participants in this survey; five of them are experts from industries, who have vast experience in packaging resource, packaging development, environmental engineering and production planning and working as an environmental scientist, a packaging specialist, packaging technologist, or a management consultant with experience of 10 to 34 years. The other four participants are researchers in environmental consultancy and studies with experience of 5 to 10 years.

6.3.2 Questionnaire structure

This section of the research justifies the questionnaire items chosen to discover the environmental impact of reusable packaging attributes. The research constructs the questionnaire based on the framework of environmental impact and the reusable packaging attributes checklist. The questionnaire includes all reusable packaging attributes, which are 23 attributes. These reusable packaging attributes come from various dimensions such as geometry, sustainability, communication and marketing; however, during the pilot studies the author found that the questionnaire was too long for the experts to participate in the study, which may confuse the participants. Therefore, the attributes are grouped into similar functionality in order to simplify the evaluation process, as shown in Table 6-2. In addition, the questionnaire involves 19 environmental impact factors. The questionnaire comprises three tables as shown in Appendix VII. The first table discovers the relationship

between all of the reusable packaging attributes and six environmental impact factors under the resources dimension. The second find the connection between 10 environmental impact factors under the waste dimension and reusable packaging attributes. Finally, the third table investigates the effect of reusable packaging attributes on global condition, which consists of three environmental impact factors.

Table 6-2: Reusable packaging attributes classification

Groups	Attributes
Health care group	Clean ability (content) Hold content safety Safe materials Packaging mass and shape Packaging characteristics (weight, dimension and material, colour, print quality, size)
Ergonometric (engineers) group	Refill ability with other product Restore ability Re-seal ability Easy ability to open and re-close (quick to use) Endurance
Environment group	Environment communication (labels, instruction for post-consumer) Recycling contents Less waste
Social group	Hygiene or easy to disinfect Meet consumers' needs Post-consumer recycling
Economic group	Packaging design Material type Costs
Marketing group	Quality and value of packaging Availability of support or services
Communication group	Instructions (product and marketing information) Incentives/rewards for use Convenience of use

6.3.3 Survey data description

The questionnaire was designed to be a source for examining reusable packaging attributes. The questionnaire was based on a multiple-item scale, which is more reliable than a single-item scale (Gliem and Gliem, 2003). The questionnaire design was based on a 5-point Likert scale (Binraman *et al.*, 2012). The nature of the questionnaire is to discover the relationship between reusable packaging attributes and environmental impact factors through asking the experts, based on their experiences, the extent to which they believe that the 23 reusable packaging attributes have affected the environment in terms of resources, waste and global condition. The scale ranged from very high impact to no

impact, where 5 denotes that the packaging attribute has a very high impact on the environment whereas 1 indicates that the packaging attribute does not have any effect on the environment. The questionnaire has one section at the end for participants' comments. It focuses on experts' experiences in the field of environmental impact and packaging in industry and academia. The questionnaire does not mention any specific packaging type and does not ask for specific gender, age or country of the participants but was mainly concentrated on the experts in the field who have a good reputation in the field of environment and packaging, either academic or industrial. The questionnaire was piloted with five participants from both university and industry sectors and then refined before being sent to the experts. This questionnaire is a preliminary study in the area of reusable packaging and environmental impact. The questionnaire is presented in Appendix VII. The data related to the relationship between reusable packaging attributes and environmental impact was mainly extracted through the questionnaire and is presented in Table 6-3. Table 6-3 shows the experts' judgment about the extent to which the reusable packaging attributes affect the environment. The results will be interpreted in the next section by the factor analysis method.

Table 6-3: Data from experts' questionnaire

	Health care group	**Ergonomist group**	**Environment group**	**Social group**	**Economic group**	**Marketing group**	**Communication group**
Primary energy	2.33	2.33	2.50	2.33	2.67	2.33	2.17
Net energy	2.50	2.50	2.67	2.50	2.83	2.17	2.33
Fossil fuel consumption	2.83	2.83	3.50	3.00	2.67	2.67	2.50
Oil and gas use	2.17	2.67	3.17	2.67	3.00	2.83	2.50
Electrical use	2.67	2.83	3.00	2.50	3.17	2.83	2.67
Raw material use	3.83	4.17	3.67	3.00	3.83	3.33	3.64
Photochemical oxidants	2.83	2.67	3.00	2.33	2.50	2.50	2.17
Acidification	2.67	2.67	3.00	2.50	3.00	2.50	2.50
Eutrophication	2.67	2.67	3.17	2.67	2.83	2.50	2.50
Air pollution	2.67	3.33	3.00	2.83	3.50	2.67	2.50
CO2 emissions	2.50	3.17	3.17	2.67	3.50	2.83	2.67
Effluents	3.00	3.17	3.17	2.83	3.50	3.00	2.83
Toxic wastes	3.00	3.17	3.33	2.67	3.33	2.83	2.50
Hazardous wastes	3.33	3.33	3.33	2.50	3.67	3.00	2.33
Water quality	3.00	3.50	3.50	2.67	3.50	2.17	2.67

Water quantity	3.17	3.00	3.50	2.67	3.67	2.33	2.50
Global warming	2.50	3.33	3.33	2.83	3.33	2.67	2.50
Greenhouse gas emissions	3.00	3.50	3.83	2.83	3.67	2.83	2.50
Climate change	2.67	3.33	3.50	2.67	3.33	2.50	2.50

6.4 Factor analysis with principal component analysis method

There are a lot of studies using several variables to describe objects. For example, many studies have used questionnaires that consist of a lot of questions (variables), due to the large number of questions that they address; complications could appear if some of the questions measured different aspects. The goal of factor analysis is to reduce *"the dimensionality of the original space and to give an interpretation to the new space, spanned by a reduced number of new dimensions which are supposed to underlie the old ones"* (Rietveld and Van Hout, 1993, p.254) and to explain the variance in the observed variables in terms of underlying latent factors (Ott and Longnecker, 2008). Factor analysis is also used for the possibility of using the output in further analyses (Rietveld and Van Hout, 1993). There are different approaches to locating underlying dimensions of a data set. Factor analysis with principal component analysis is one of them.

Factor analysis derives a mathematical model from which factors are estimated whereas PCA merely decomposes the original data into a set of linear variables. The method in this chapter is factor analysis with PCA. This is a technique that helps to cluster a group of variables. Therefore, exploratory factor analysis helps to identify a set of variables and construct a questionnaire to measure an essential variable. Factor analysis with principal component analysis is concerned only with establishing which linear components exist within the data and how a particular variable might contribute to that component. Field (2005) found that principal component analysis is a psychometrically sound procedure and it is less complex than factor analysis; it is a discriminant analysis. Factor analysis with principal component analysis method can be used to discover the relationship between environmental indicators and reusable packaging attributes.

6.4.1 Calculation, results and analysis

The result of this method is to explain the cohesive structural relations between reusable packaging attributes and environment impact indicators by subjecting the data to principal factor analysis with varimax rotation. In the beginning, the determinant of the correlation

matrix amongst variables is vital for testing multicollinearity. It can be checked by identifying the determinant that is generated by SPSS at the bottom of the correlation matrix.

The determinant is an important tool in factor analysis, which describes the area of data. If the determinant is greater than 0.1×10^{-4}, then all the variables' correlation is significant (Field, 2005). In these data, the determinant is 0.005 > 0.00001, which means that there is no multicollinearity. The factor analysis also considered sample size. The reliability of factor analysis is dependent on sample size (Field, 2005). The sample size can be tested by using the Kaiser-Meyer-Olkin measure of sampling adequacy (KMO) (Kaiser, 1960). By using SPSS, the KMO = 0.80 ('Very good', according to Field, 2009), and all KMO values for individual items were greater than 0.732, which is well above the acceptable limit of 0.5 (Field, 2009; Kaiser, 1974). Therefore, factor analysis is appropriate for these data. After that, an initial analysis was run to obtain eigenvalues for each component in the data. Eigenvalues are the elements which provide the loading of a particular variable on a particular factor and the variances of the factors. Eigenvalues represent the amount of variation of a factor, as the factor analysis deals with the correlation of variables and each variable has a variance of 1. As shown in Table 6-4, components 1 and 2 had eigenvalues over 0.7 (as Field (2005) cited in Jolliffe (1972) recommended eigenvalues more than 0.7) and account for 75 % of the variance. Also in Figure 6-1 shows that the factor eigenvalues between component 1 and component 2 are large; however, the difference of others is much smaller. Therefore, as the first component explained relatively large amounts of variance, the research ran the data again with eigenvalues 1. This can express all the reusable packaging attributes groups that contain all 23 attributes.

Table 6-4: Total variance explanation with principal factor analysis in experts' data

Component	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.572	65.313	65.313	4.572	65.313	65.313	3.182	45.452	45.452
2	0.725	10.352	75.665	0.725	10.352	75.665	2.115	30.213	75.665
3	0.665	9.504	85.169						
4	0.419	5.979	91.148						
5	0.377	5.388	96.535						
6	0.142	2.035	98.571						
7	0.100	1.429	100.00						

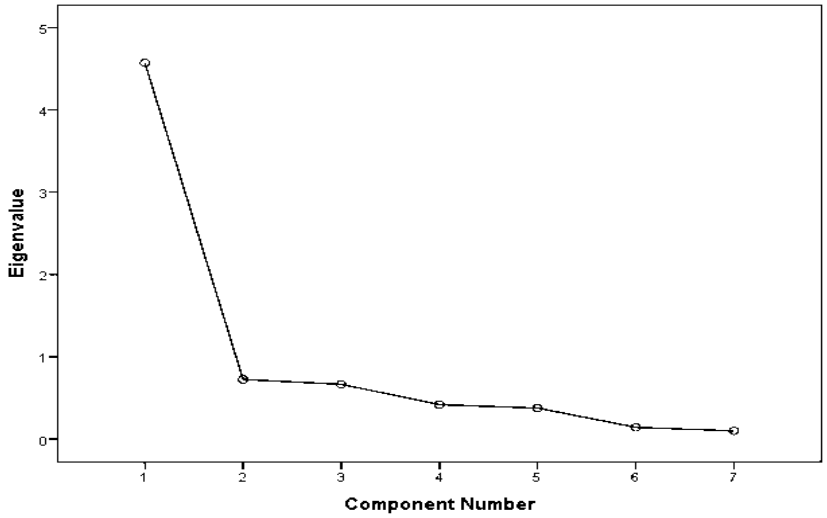


Figure 6-1: The screen plot figure of each factor's eigenvalues with the principal factor analysis in experts' data

Factor analysis with PCA combined reusable packaging attributes into one component, created by assuming unit weighting of each attribute and then averaging the attributes that loaded highly on each factor. Therefore, the result of factor analysis with PCA is a factor score coefficient matrix. This matrix in effect is useful to understand how the relationship between the variables scores. As shown in Table 6-5, the results shown that the main environmental impact of reusable packaging attributes is focused on health care, ergonomist, environment and economic groups. These groups include 15 reusable packaging attributes. As shown in the rotated attributes, the reusable packaging attributes that had the greatest effect were related to ergonomist and environment groups, which involved eight attributes, as demonstrated in Table 6-2. Note that these eight attributes that are rated most highly in importance are characteristics that have general implications for the environment, such as resources. The second impact attributes group comprises the health care and economic groups, and its attributes represent characteristics that are related to the qualities that are related to the composition of the reusable packaging, which includes seven attributes, as demonstrated in Table 6-2. Finally, the third impact attributes group is the social group attributes, which is related to both resources and the composition of the reusable packaging such as post-consumer recycling and easy to disinfect. The last two groups, which are the marketing and communication groups, had less impact on the environment because they are related to marketing and human responsibility through the idea that reusable packaging should be available in the market, contain value and quality, involve instructions, give incentives and be convenient to use.

Table 6-5: Matrix of rotated factor score coefficient of principal factor analysis in experts' data

Reusable packaging attributes groups	Component
	1
Health care group	0.722
Ergonomist group	0.836
Environment group	0.881
Social group	0.563
Economic group	0.791
Marketing group	0.199
Communication group	0.449

For further analysis, the author checked the soundness of these composites by calculating the internal consistency reliability of each factor. The value of the Cronbach's Alpha coefficient for component 1 was 0.89, which is indicating good reliability. This chapter is going to conclude by presenting and discussing the findings and their impact on theory and managerial practice.

6.5 Discussion

Efficient packaging is one way to reduce the environmental impact of the amount of packaging disposal. Packaging can be difficult to tackle and thereby cause environment problems. If packaging is designed to decrease environmental impact, all of its fundamental functions (protection, convenience, communication) can be addressed. Reusable packaging can be one possible solution to reduce the burden on the environment from packaging through its attributes. The reusable packaging attributes may influence buying or using behaviour directly or indirectly. Consumer behaviour probably has the largest impact on the environment but packaging, as a provider of prerequisites for service, may influence behaviour through its attributes. It is particularly important to reduce throwing away packaging in the consumer mind as the accumulated environmental impact of packaging increases with each step in the packaging life cycle. Hence, reusable packaging attributes are stated to be important to the environment from this research, which has conducted an empirical study to discover the relationship between reusable packaging attributes and environmental impact. The results have shown that 15 out of 23 attributes from the reusable packaging attributes checklist have an impact on the environment in various dimensions.

The first dimension has an environmental impact from the resources, and this dimension includes refill ability with other product, restore ability, re-seal ability, easy ability to open and re-close, endurance, recycling contents, less waste, post-consumer recycling and environment communication (labels, instruction for post-consumer). This result is consistent with Ebreo *et al.* (1999), who studied the impact of product attributes on the environment, and found that the attributes that are very important were related to the resource used in the product such as reusable, refillable, packaging in recyclable materials, packaging in reusable containers, made by companies that support the environment, and limited amount of packaging. It seems that there is a clear correlation in the sense that these attributes have a direct impact on resources such as energy, raw material, fossil fuel consumption, oil and gas use and electrical use. This impact on resources could be positive or negative. Packaging itself normally has only a small impact on the environment (Jorgen Hanssen, 1998), but from the materials from which it is made can have a larger environmental impact. For instance, there are some examples of packaging that represents up to 20% of the global warming potential (Andersson *et al.*, 1998), and other studies have shown the negative environmental impact of packaging from the amount of energy used if the packaging is produced from materials that affect the environment. This leads the research to highlight that the importance of environmental impact comes from the composition of the reusable packaging attributes, which include material type.

The environmental impact of eutrophication and acidification is dominated by agriculture, while global warming and energy use are dominated by the original product, which may contain some animal products that have high environmental impact. As De Monte *et al.* (2005) recommend, particular diligence regarding the selection of materials used for packaging production is an element required during the packaging design phase. Therefore, the research can find that the attributes of reusable packaging will almost certainly try to reduce the total environmental impact both for eutrophication and acidification, and probably also reduce the total global warming if natural material is used in producing reusable packaging. In addition, in some cases, if there is an increase in the energy used during producing reusable packaging, this can be justified by large reductions of emissions (Williams and Wikström, 2011; Williams *et al.*, 2008). To give one example from the literature review, Ross and Evans (2003) found that the new reusable EPS-HIPS/PE shrink-wrap packaging has less life cycle impact in terms of oil consumption, photochemical oxidant, nitrogen oxides and energy input than current EPS/PE packaging.

Packaging mass, shape and characteristics (weight) have also shown environmental impact. It may be due to the weight of package production which could be related to raw materials used for the packaging, as De Monte *et al.* (2005) found. An improvement in the packaging mass and shape and packaging characteristics (weight, dimension and material, colour, print quality, size) attributes present during producing reusable packaging could decrease the risk of negative environmental impact. This may be because more functions might be added, or a new surface may need to be enhanced in order to add more endurance to packaging. If the shape of a package is altered to make the packaging more reusable, this can influence the efficient transport of the product. Therefore, the results have shown that improving the composition of the reusable packaging has an impact on the environment but it needs more investigation on a specific packaging to determine the environmental impact of changing the packaging design to be reusable.

The third dimension in the impact attributes group is the social attributes group. It is related to both resources and the composition of the reusable packaging, such as post-consumer recycling and ease to disinfect. The results have shown that this group indicated moderate value, which shows its impact on the environment. This is due to its concentration on the importance of the packaging to be easy to disinfect and post-consumer recycling, which may need the packaging to be designed from specific material, and this could affect the environment positively or negatively. The other attributes in the social group, such as meeting consumers' need and costs, do not seem have an impact on the environment, which may lead this group of attributes to have a moderate value rather than a high value as the ergonometric and environment groups.

The final dimension in the reusable packaging attributes checklist has no impact on the environment due to its characteristics, which focus on marketing and human responsibility. They are quality and value of packaging, availability of support or services, instructions (product and marketing information), incentives/rewards for use and convenience of use. They may represent so many different things. The quality and value of packaging attribute and convenience of use are unspecified and, to some extent, included in the other attributes. Availability of support or services and instructions that help the customer to reuse the packaging and provide better information about how to reuse packaging in the right way will probably not lead to increased environmental impact. Moreover, incentives/rewards for use that have to do with the marketing only, such as discount given and some points added to the loyalty card, will not have an environmental impact. Therefore, it is difficult

to provide general conclusions regarding the environmental impact of these attributes, so these attributes should not be included in the environmental impact evaluation. However, although this argument about the increase in initial price of a product designed to utilise reusable packaging has been raised, it can be solved if there is high competition between companies. For instance, Coca-Cola produced refillable packaging with a lower price than one-way packaging due to the prevalence of refilling and the competition which occurred amongst companies (Rowe and Platt, 2002). Therefore, this chapter has given only a simplified treatment to the area of reusable packaging and the environment. The results from this chapter can be linked to the previous chapter's results, so the reusable packaging attributes checklist can be more valuable, which indicates the level of environmental impact of reusable packaging attributes as shown in Figure 6-2.

Reusable packaging attributes checklist

Product's packaging name: Company name:

		Meet	Not Meet	Not related
Essential reusable packaging attributes	**Level of environmental impact**			
Refill ability with other product	High			
Clean ability (content)	High			
Hold content safety	High			
Re-store ability	High			
Re-seal ability	High			
Easy ability to open and re-close (quick to use)	High			
Endurance	High			
Packaging mass and shape	High			
Safe materials	High			
Packaging design and materials type	High			
Environment communication (labels, instruction for post-consumer)	High			
Costs	Low			
Post-consumer recycling	Low			
Hygiene or easy to disinfect	Low			
Meet consumers' needs	Low			
Recycling contents	High			
Less waste	High			
Quality and value of packaging	Low			
Optional reusable packaging attributes				
Packaging characteristics (weight, dimension and material, colour, print quality, size)	High			
Instructions (product and marketing information)	Low			
Availability of support or services	Low			
Incentives/rewards for use	Low			
Convenience to use	Low			

Figure 6-2: Reusable packaging attributes checklist with level of environmental impact

Hence, the reusable packaging attributes checklist could be a practical reference for manufacturers when designing reusable packaging to consider the reduction of environmental impact during implementation of reusable packaging attributes. In addition, the reusable packaging attributes checklist could be employed in the adoption of environmental initiatives, and could influence the authorities who want to reduce the total environmental impact of packaging to reconsider the functions of packaging, which should be more highly prioritised in the packaging directive. The reusable packaging checklist can also be useful for packaging developers as, the checklist can inform them that reusable packaging attributes and environmental aspects are affected by many factors.

6.6 Summary

This study shows that the information in the survey on the reusable packaging attributes checklist which was identified in the previous chapter is useful from an environmental perspective. The topic in this chapter was chosen because there has been no investigation of the environmental impact of reusable packaging attributes made in the area of academia and marketing. In this chapter, the environmental impact of reusable packaging attributes and the balance between the two has been examined through experts' opinions. There were many connections between reusable packaging attributes and environmental impacts. The approach presented in this chapter can help to identify environmental impact when packaging is designed using the reusable packaging attributes checklist. The results show that the reusable packaging attributes checklist can be an important tool by which to reduce the total environmental impact.

For the final stage of demonstrating the entire enhancing reusable packaging framework, it is necessary to investigate a specific case of reusable packaging in the following chapter in order to observe the implementation of the framework in reality.

CHAPTER 7: Case study

7.1 Introduction

In 2008, Starbucks set a number of goals in order to develop its performance: ethical sourcing, environmental stewardship and community involvement. Each goal has various strategies to meet. Starbucks states that it exerts the greatest effort in fulfilling these goals. Starbucks always concentrates on customers, partners (employees), non-governmental organisations and investors in order to implement its goals. It focuses on health, wellness and workplace policies. As Starbucks is global, it also focuses on operated retail stores, global supply chain operation, social, environmental and economic impacts. It uses the Credit360 program to manage the sustainability data, tracking key performance indicators, and for approval and audit purposes (Starbucks, 2013).

7.1.1 Environmental practices

According to the Starbucks annual report, the company knows that the complexity of climate change requires it to think beyond its current action towards the environment. The Starbucks approach is to reduce the environmental impact in all aspects of its business. In the buildings, Starbucks seeks to have green stores which provide energy efficiency through saving energy and water and increasing recycling activities. In pursuing a green store, Starbucks concentrates on green building initiatives to meet long-term environmental impact and cost reduction. In 2013, Starbucks pushed most of its new or existing stores to meet the US Green Building Council's and Leadership in Energy and Environment Design (LEED) certification standards, and around 65% of its stores achieved LEED (Leadership in Energy and Environmental Design, 2014). In the conservation of energy and water, Starbucks incorporated conserving water and energy strategies into its store design, equipment use, and operation and maintenance systems. According to the Starbucks annual report (Starbucks, 2013), in 2008, Starbucks set a goal of reducing water consumption by 25% by 2015. Today, Starbucks is on track to achieve this goal as it has reached a 21% reduction of the water used in its stores; this has been achievable by implementing new reverse osmosis filtration retrofits in 503 stores in the US and Canada. Reverse osmosis provides a high level of water filtration. Moreover, for energy reduction, Starbucks set a goal in 2008 of reducing energy

consumption by 25%. Starbucks has tried to implement a number of initiatives to reduce electricity used, but in 2013 the decrease was only 7.1%, which needs improvement. Starbucks has applied energy management systems and these require the equipment providers to design the equipment to be operated at energy-efficient levels. In addition, regarding forest conservation, Starbucks helped farmers in Indonesia save 250,000 trees and participated in the distribution of 200,000 trees in Brazil as well. Moreover, Starbucks seeks to reduce its environmental footprint through mitigating the impact of supply chain, product packaging and equipment used (Starbucks, 2013).

One of the areas in which Starbucks seeks to reduce environmental impact is through recycling its waste. In 2009, Starbucks implemented recycling in 18 markets after initiating three recycling pilot tests. Starbucks tested the capability of post-consumer recycling during a six-week pilot project and, according to the Starbucks annual report, the company has proven that its cups can be accepted as a valuable raw material in the recycling system. However, Starbucks faces some issues regarding recycling, such as some communities recycle the Starbucks paper cups and others do not have the infrastructure in place to handle collection, hauling and processing due to a lack of demand for the cups' material by the recycling industry. The challenge with recycling the cups is not as simple as putting a recycling bin in every store. Once the consumer puts their cup in the bin, it needs to go somewhere where it can actually be recycled. Also, recycling infrastructure varies widely around the world; hence the Starbucks decision to do its part by implementing efficient and effective recycling strategies by enhancing recycling in its stores. The Starbucks goal is to ensure all the cups are recyclable by 2015. In 2008, Starbucks set a goal of applying front-of-store recycling in all locations because the company found that customers take their beverages outside the store and it is important to develop comprehensive recycling solutions to address this issue. In 2013, 39% of stores implemented front-of-store recycling for customers, which indicates a strong acceptance rate amongst the recycling industries, although there are limitations of recycling technology or inconsistent public policy, lack of infrastructure, and operational challenges in some areas (Starbucks, 2013).

Moreover, back-of-store recycling is another way of recycling in the working area. In 2013, there were 80% locations that had implemented back-of store recycling. However, there are limitations to the application of this type of recycling in all stores, such as operational issues, minimal store space, lack of commercial recycling services and the

refusal of landlords to provide recycling services on the site. Today, according to the Starbucks annual report (Starbucks, 2013), 67% of Starbucks stores offer recycling facilities with front-of-store and back-of-store recycling in the US and Canada. Also, Starbucks is working with non-governmental organisations, policymakers and competitors to analyse packaging flow through recycling facilities and assessment of the causes for the lack of current recycling services.

Moreover, Starbucks has conducted some activities that support the reuse practices for some materials. For instance, Reclamation Drive-Thru. Starbucks used shipping containers to design these stores. The idea was inspired by the sourcing of coffee and tea, which come from around the world. After many journeys, many containers end up in scrap yards once they reach their average 20-year lifespan. The Reclamation Drive-Thru idea was inspired by a desire to help keep the container used throughout the supply chain. This takes the container out of the waste stream. The results show that a 450 square foot drive-thru and walk-up store can be made from four containers (Allison, 2011). The whole store is contained within the shells of four containers that have been reclaimed, refurnished, renewed and revived. This idea was implemented in Tukwila, Washington.

This is one example of the Starbucks environmental practices to reduce the environmental impact of waste packaging. Starbucks generates four billion paper cups a year (Gunther, 2012) and most of them end up in landfill. Owing to this, Starbucks introduced "for here" mugs in 2008, which allows customers to reuse their own mug, which can have their name on and be left in the store. However, Starbucks found there is a barrier to the use of "for here" mugs in that it is difficult to track them. Then, Starbucks modified its goal in order to increase use of reusable cups in 2011 and 2012 by charging customers 10% more for every paper cup they used whereas the customers who brought their own mug were offered 10% off the price of a beverage. However, the results have shown that the percentage of beverages served in personal cups remained static (Gunther, 2012; Davies, 2013). Hence, Starbucks again amended its goal to increase the usage of personal cups by introducing reusable cups, which are less expensive than other cups because they are made of a lighter material. The initial goal was to increase the number of users of reusable cups to 25% by the end of 2015 but, according to Berr (2013), the high percentage of sales of disposable cups, which reached 80%, would make it difficult to increase the number of reusable cup users. So,

the goal was later scaled back to increase the number of users of reusable cups to 5% by the end of 2015. It costs the customer £1 per reusable cup and the scheme was launched in the UK in April 2013. As shown in Figure 7-1, the cup is solid and dishwasher-safe. According to the Starbucks official statement (Davies, 2013), it can be re-used thirty times. Unofficially, the cup's manufacturer has test-washed cups over 170 times without any impact on performance (Davies, 2013). As this research concentrates on reusable packaging from various dimensions and has designed a conceptual framework in order to enhance reusable packaging, it is going to implement the Starbucks case and contribute to identifying a possible solution for Starbucks to continue increasing the number of beverages served in reusable cups. This is achievable through looking at customers' intentions and behaviour towards reusable cups. At this stage, the research will investigate the customers' behaviour and identify the drivers towards using reusable cups. Then, the research will look at developing reusable cup attributes by comparing them with a reusable packaging attributes checklist. In this stage, the research will suggest some attributes that could be added to the current design to contribute to increasing the number of customers using the Starbucks reusable cups. Finally, the research will look at the environmental impact of the current Starbucks reusable cup in order to find out how the Starbucks reusable cup can protect the environment, conserve energy and save forests.

Figure 7-1: The Starbucks reusable cup

7.2 Customers' intentions and behaviour towards reusable cups

As social aspects play an important role in enhancing the use of reusable cups, the importance of discovering people's attitudes towards this issue is very useful to increase reuse behaviour amongst society. Once these attitudes have been identified, it will be possible to realistically tackle the full range of society's behaviours. In order to identify

the aspects that are relevant to enhancing using reusable cups from a social perspective, various variables such as norms, knowledge and communication about packaging reuse, social and personal values, and environmental awareness need to be measured. As Starbucks has already introduced reusable cups and is thus controlling customers' behaviour, it needs to identify what other factors are influencing customers to use its reusable cup such as norms, social and personal values, knowledge about the Starbucks reusable cup, and awareness of environmental issues, values and consequences of using the Starbucks reusable cup. In this section, the research is going to use the SD model which was generated in Chapter 4 to simulate the current situation of social behaviour by conducting a case study amongst Starbucks users in order to identify if the current situation will lead Starbucks to achieve its goal of increasing use of its reusable cup. If not, possible solutions and suggestions for Starbucks will be made through sensitivity analysis.

7.2.1 Questionnaire formulation and structure

A questionnaire was designed to address the Starbucks case and was piloted amongst university supervisors and researchers in order to validate it and then it was refined before being distributed. The questionnaire was designed by the Questionnaire Designer Website, which generated a link. This link is suitable for online distribution to people, and was also used when meeting participants in a coffee shop, when they were able to fill in the questionnaire on an iPad instead of on paper. During the pilot test of the questionnaire, two questions were added in order to ensure that the participants had either used the Starbucks reusable cups or had at least heard about them. The author decided to allow participation in the study of people who had not used the Starbucks reusable cup but who had heard about it. However, the research would not allow participation in the study of people who had neither used the Starbucks reusable cup nor heard about it, because this is an indicator of lack of awareness about the Starbucks reusable cup and it would influence the research results. These types of participants were accounted for in the research as well. During the pilot test of the questionnaire, some sections of the questionnaire were not considered such as PBC, which refers to packaging already in the market and available to use. Also, the number of questions was reduced in order to measure one variable instead of using three or four questions to measure one variable; the questionnaire only used one question or sometimes used two questions to measure one variable if it was necessary. The main reason behind that is to

increase the number of participants in this case study when visiting them in the stores. Also, it is a very quick way for the participants to complete the questionnaire without any possibility of leaving the questionnaire in the middle due to feeling bored with repeating questions that measure the same things. Hence, the number of questions was reduced from 50 to 23 as follows:

- *Social demographic*: community residents were asked about social-demographic factors including gender, age and education level. This assesses the representativeness of the sample by comparing the demographics of the sample with the demographics of the country.
- *Social and personal norms*: social norms originate from internal and external references. The questionnaire just asked two questions: one for internal reference, which combined all the internal references such as parents, friends and relatives, and one for external reference, which included the organisation and government agents.
- *Perceived knowledge:* perceived knowledge about the Starbucks reusable cups is a latent variable which reveals the individual use. In this questionnaire, because the Starbucks reusable cups are already on the market, specific knowledge about when the reusable cups can be reused and how many times the participants had used the cup were removed. The only question that remained concerned whether or not the participant had any knowledge about how to get rid of reusable cups. Communication is another vital way of conveying a message to consumers. In this questionnaire, one question asked if the participants received any information about reusable cups through Starbucks, television, radio and newspapers and if this information convinced the participants to use reusable cups.
- *Perceived personal and social value*: this questionnaire about the Starbucks reusable cups divided the attitudinal beliefs into two groups. It measured personal values through three questions related to personal benefits from the Starbucks reusable cups such as money, affecting children's behaviour and affecting reputation. Social values were measured through three questions related to: saving natural resources, reducing environmental pollution and reducing waste-handling costs.
- *General environmental concern*: in this questionnaire, environmental concern was measured using a composite method through four questions about environment

issues and values and the awareness of consequences of using the Starbucks reusable cups.

Moreover, there is a question at the beginning of the questionnaire which asks the participants whether or not they have ever used the Starbucks reusable cup and if they have heard about it or not.

7.2.2 Questionnaire process and data collection

The questionnaire design was based on a 5-point Likert scale, as designed in Chapter 4, and the scale of the questionnaire ranges from strongly agree to strongly disagree. The questionnaire has one section at the end for participants' comments about providing some suggestions in order to make the Starbucks reusable cups more attractive to people. The questionnaire focuses on customers who have used the Starbucks reusable cup or heard about it. The questionnaire does not concentrate on specific gender, age or country but mainly concentrates on Starbucks users. The questionnaire was distributed randomly online only via email to a group of students as well as non-students, employees and non-employees. Also, the questionnaire link was diffused through social networks such as Facebook and Twitter from April 2014 to May 2014. In addition, the questionnaire was filled in with participants during a meeting in a coffee shop. In turn, those participants were asked to forward the questionnaire link to as many people as possible using the snowball sampling concept, 'who-knows-who' strategy. The questionnaire is presented in Appendix VIII. There were 141 participants. The participants who did not complete the questionnaire and had not used or heard about the reusable cup were rejected, with the rejection rate being around 24%. From the participants who fully completed the questionnaire, 29 had used the Starbucks reusable cup whereas 112 participants had not ever used it but had heard about it. With regard to gender, the participants were split between 72.5% male and 27.5% female. Just under 50% of the participants (49.64%) were in the age group 21-30, whilst 34.75% were in the age group 31-40. Only a few participants (6%) were under 20 or over 41 (9%). For education level, the largest group was for master's degree (54.60%), whilst 26.36% of participants had a bachelor's degree, and only 9% had a PhD. The participants' behaviour and intentions related to the Starbucks reusable cup were mainly extracted throughout the questionnaire, as shown in Table 7-1. The results have shown that there is a high level of awareness amongst the participants about environmental issues of waste packaging, environment values and the positive consequences on the environment of using the Starbucks reusable cup. There is a high level of personal and social value

through using a Starbucks reusable cup amongst participants. The two low categories are the perceived knowledge about the Starbucks reusable cup and the influence of the relative and friends norms, which need more effort to develop awareness. The analysis of these data will be presented in detail in the next section using an SD model.

Table 7-1: Average number of people who were influenced to use the Starbucks reusable cup from questionnaire data

Influence from		**Influence from**	**Influence from awareness about environment**			**Influence from**	
Friends' Norms	Relative Norms	Perceived knowledge	Issues	Values	Consequence	Personal value	Social value
2.88	2.88	2.57	3.93	3.87	4	3.80	3.51

7.2.3 SD model results

Customer adaptation of the new reusable cup can be a big challenge facing the Starbucks Company. If the adaptation rate is low, it would take very long to diffuse use of the Starbucks reusable cup. Customer adaptation is not just a matter of picking up the new packaging design and going to use it; it takes time and effort for the customer to become convinced to use the reusable cup. The SD model in Chapter 4 is not just looking at users and non-users of reusable packaging only, it is also looking at how to increase the knowledge, awareness and adaptation of people who currently do not use the Starbucks reusable cup so that they can then become users.

The author runs the model from day 1 to day 365. The key parameters in the model are perceived knowledge, personal and social values, general environmental concerns, influence from friends' norms, influence from relatives' norms, better condition of product packaging and perceived convenience. The results show that in the current situation Starbucks will reach about 11459 users of its reusable cup by the end of 2015, as shown in Figure 7-2. The model diverges after 32 days with purely exponential growth. As shown in the data, there is a low level of knowledge about the Starbucks reusable cup and influence of the norms amongst the participants in this case study. Therefore, this is significant and needs to be developed in order to increase the number of users of the Starbucks reusable cup.

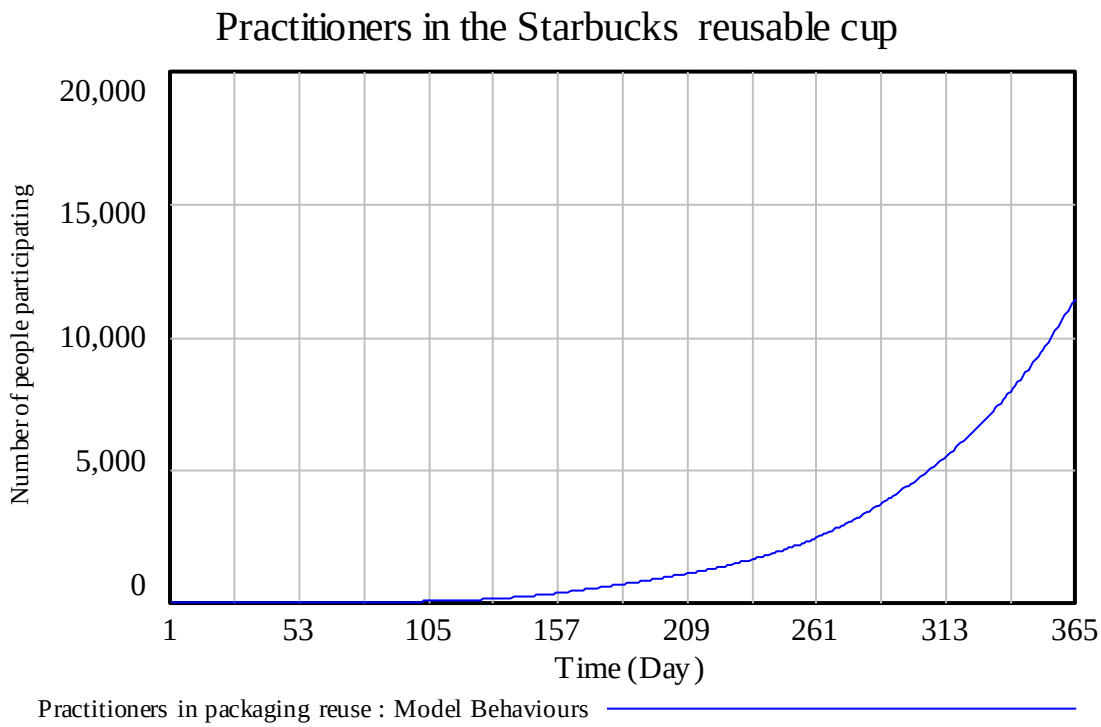


Figure 7-2: Number of the Starbucks reusable cup users after model simulation

The low values regarding knowledge about the Starbucks reusable cup and the influence of the relatives and friends' norms have an impact on the social behaviour during the simulation period. Therefore, it is necessary to investigate this by creating a scenario that allows some control for increasing the knowledge about the Starbucks reusable cup amongst society and developing the influence of the relatives and friends' norms. The created scenario helps in determining how the number of users would be increased if there is development in the diffusion of knowledge about the Starbucks reusable cup amongst people and an increase in the level of influence of personal and social norms such as those of friends and relatives. The scenario is to consider whether a focus on increasing knowledge about the Starbucks reusable cup amongst people, and relatives and friends' norms would contribute to an increase in people who are using the Starbucks reusable cup. The key parameters in the scenario are perceived knowledge, influence from friends' norms and influence from relatives' norms. The results in Figure 7-3 show that there is an increasing number of users, which is projected to reach 23406 users by the end of 2015.

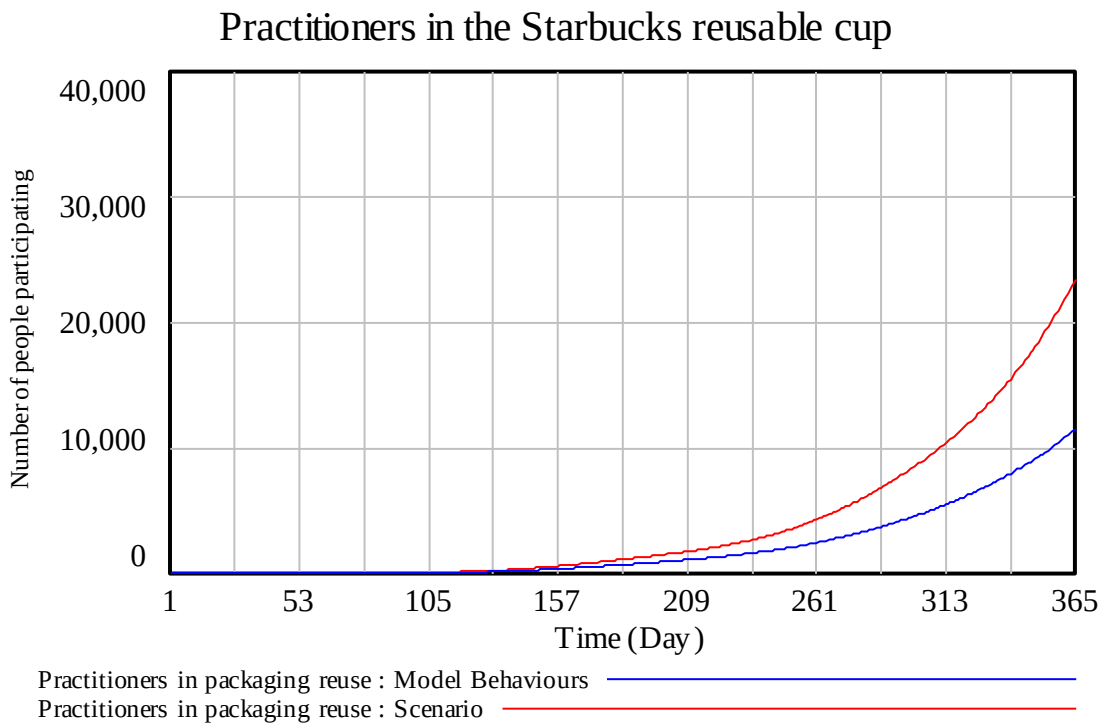


Figure 7-3: Scenario results of developing knowledge and norms about the Starbucks reusable cup

As the results in Chapter 4 have shown, the knowledge about packaging reuse is tantamount to encouraging user behaviour; the results for the Starbucks reusable cup also show how knowledge about the reusable cup is important in order to increase the number of users. There is a high satisfaction amongst participants about the reusable cup because there is high awareness amongst them about environmental issues and values and consequences of using reusable cups, and also there is high demand to gain personal and social value from reusable cups. These results can approve the results obtained in Chapter 4 that focused on enhancing general environmental concerns about reuse of packaging and increasing personal and social values of reusable packaging, which makes the customer more informed about new reusable packaging design. Moreover, the influence from friends and relatives has shown its effect in the number of the Starbucks reusable cup users. This can confirm that maintained norms' effect on reusable packaging has a direct influence on people. Finally, it is obviously shown from the results of the questionnaire about the Starbucks reusable cup how important a reusable packaging design is in order to dominate the packaging reuse activities amongst customers. This confirms the results obtained in Chapter 4 that change in the parameter better conditions of product packaging and perceived convenience can influence people to reuse packaging and reduce the amount of packaging disposed of.

7.3 Reusable cup attributes

In this section, the research is going to evaluate the Starbucks reusable cup attributes with the reusable packaging checklist which was generated in Chapter 5. The Starbucks reusable cup meets some of the essential reusable packaging attributes. The research found that 15 attributes obviously matched the Starbucks reusable cup and the reusable packaging attributes checklist, as shown in Table 7-2. There is one attribute that does not relate to the Starbucks reusable cup, which is re-seal ability, due to the nature of the packaging, which is designed to be refillable through opening a lid. However, the research clearly found that there are some attributes of the Starbucks reusable cup which were not considered during the design process, such as environment communication, instructions and availability of services (see Chapter 5 for more details). Moreover, the research found that there are also some attributes that Starbucks has considered but which need more justification from the Starbucks reusable cup users to clarify to what extent they are satisfied with these attributes, such as how the Starbucks reusable cup characteristics (weight, dimension, colour, print quality, size) meet their need, incentives/rewards for use and convenience to use.

Table 7-2: Comparison between the Starbucks reusable cup and the Reusable packaging checklist

Dimensions	Attributes	The Starbucks Reusable cup
Geometry/ergonomics	**Refill ability with other product***	√
	Clean ability (content)*	√
	Hold content safety*	√
	Re-store ability*	√
	Re-seal ability*	No need
	Easy to open and re-close (quick to use)*	√
	Endurance*	√
	Safe materials*	√
	Packaging mass and shape*	? (Need customer justification)
	Packaging characteristics (weight, dimension and material, colour, print quality, size)	
Sustainability	**Packaging design and materials type***	? (Need customer justification in packaging design)
	Environment communication (labels, instruction for post-consumer)*	×
	Costs*	√
	Post-consumer recycling*	√
	Hygienic or easy to disinfect*	√
	Meet consumers' needs*	? (Need customer justification)
	Recycling contents*	√
	Less waste*	√
Marketing and communication	Quality and value of packaging	√
	Instructions (product and marketing information)	×
	Availability of support or services	×
	Incentives/rewards for use	? (Need customer justification)
	Convenient to use	? (Need customer justification)

* **Essential attributes**

As shown in Table 7-2, some attributes need justification from users. The main aim behind that is to improve these attributes, which is difficult from the research point of view to justify because they relate to customer orientation. Therefore, the author decided to include one section in the questionnaire, which was conducted in the previous section, asking customers who use the Starbucks reusable cup about their satisfaction with these attributes, as shown in Appendix VIII. Moreover, the questionnaire also included one open question about if there are any extra functions that the user can suggest should be added to the Starbucks reusable cup.

7.3.1 Results of justification for some of the Starbucks reusable cup attributes

Although the results show that the users of the Starbucks reusable cup are satisfied with the cup's characteristics and design, they also show that there are some attributes that should be considered if the company seeks to increase the number of users, such as environment communication (labels, instructions for post-consumers), and instructions (product and marketing information). In addition, the results show that the participants are neutral with regard to the incentives/rewards that are given to them when they use a Starbucks reusable cup. Hence, Starbucks needs to concentrate more on incentives/rewards for using the reusable cup. Moreover, Starbucks needs to concentrate on availability of support or services relating to the reusable cup.

As the results in Chapter 5 have shown, the reusable packaging attributes checklist can be a guide to meeting the European standard 'BS En 13429:2004 reuse of packaging'. In this case study, the Starbucks reusable cup met the requirements of packaging: that it must be capable of reuse through its attributes, which are refill ability, clean ability, portability, re-store ability, characteristic of the reusable cup, endurance, packaging mass and shape and packaging handle shape. Also, Starbucks met most of the procedures under the requirement 'reconditioning system of packaging'. However, there are some procedures that Starbucks did not successfully meet: the requirement of keeping the packaging safe during refill, as demonstrated in participant recommendation results from customers that the cup preserves heat – shown by the reported difficulty to hold hot drinks; and Starbucks has also not considered explaining to users how to reuse the reusable cup in an appropriate way. The research found that the company was unsuccessful in meeting some of the procedures because it did not consider the entire reusable packaging attributes checklist. Therefore, the research can suggest that the

reusable packaging attributes checklist can be a guideline for Starbucks to meet European standard 'BS En 13429:2004 reuse of packaging'.

7.4 Environmental impact of the Starbucks reusable cup

As mentioned in Chapter 6, packaging can cause environmental issues if full consideration is not given to designing sustainable packaging. If the packaging is designed to reduce environmental dilemmas, all the important functions can be addressed. In this section, the research is going to examine the environmental impact of producing the Starbucks reusable cup. It is really helpful to discover if the Starbucks reusable cup can reduce the environmental impact or not. As Starbucks is trying to promote a more sustainable behaviour and has branded itself as an eco-friendly company, each new design may provide and add an option for a different environmental segment, as there will never be a solution with zero environmental impact. The Starbucks Company has used external organisations to validate if the new reusable cup design has environmental impact or not. Data source about the Starbucks reusable cup was analysed using the Environmental Paper Network Calculator. The raw material and post-consumer recycling were validated by the paper suppliers. The compost ability, re-pulp ability and potential environmental benefits of the Starbucks reusable cup were researched and validated by Cedar Grove, Western Michigan University and the Environmental Paper Network Paper Calculator. Hence, the research can compare the environmental impact of the Starbucks reusable cups and the results discovered in Chapter 6 about the environmental impact of reusable packaging. The research is going to find out how Starbucks claims to save the environment through concentration on reusable cup activities.

Although Starbucks reusable cup have most of the reusable packaging attributes, the Starbucks claims that they reduce the environmental impact of procuring one-way packaging through reusable packaging. As Starbucks reusable cup includes the majority of the attributes that consume resources, such as energy, raw material and fossil fuel consumption, oil and gas use and electrical use, however Starbucks designed its reusable cup to be recyclable and have recyclable contents, as shown in the cup itself. This is a clear indication that increasing demand for the Starbucks reusable cup leads to reducing the amount of resources consumed and helps Starbucks to reach its goal of reducing energy consumption. Moreover, according to the Starbucks global

responsibility report, the material used in reusable cup is very light, and a pound of paper or 3.5 pounds of wood is saved if the user uses this cup daily for a month, which indicates a good sign for the saving of resources. The cups and lids are 100% polypropylene (#5) plastic, which does not leech into the cup at boiling temperatures. According to the Starbucks Environmental Affairs Director Jim Hanna, *"polypropylene has the lowest manufacturing carbon footprint of any plastic cup"* (Davies, 2013). It must be borne in mind that some environmentalists claim that all plastic has a negative impact on the environment, but it is not under the remit of this research to investigate this. However, it can be noted that the materials are recycled rather than virgin polypropylene and the use of recyclable plastic leads to some environmental benefits such as reduction of energy consumption, water usage, sulphur dioxide, nitrous oxide and carbon dioxide generation (Waste Online, 2014). Although polypropylene (#5) plastic has a recycling limitation in that some municipalities cannot accept it due to lack of technology, the Gimme 5 recycling programme has solved this matter by turning polypropylene (#5) plastic into new products such as toothbrushes or razors (Preserve products, 2014).

The shape, mass and characteristics of packaging of the Starbucks reusable cup did not have any negative environmental impact according to the Starbucks global responsibility report (Starbucks, 2013) and, in theory, the following have stated that the cup has potential environmental benefits: Cedar Grove, Western Michigan University and Environmental Paper Network Paper Calculator. This can give the indication that creating more functions for reusable packaging might not increase the risk of negative environmental impact, as Williams *et al.* (2008) found that there is no impact on the efficiency of transportation if there is reusable packaging. In addition, as Chapter 6 has shown, some reusable packaging attributes such as post-consumer recycling and being easy to disinfect have moderate environmental impact. In this case study, as the Starbucks reusable cup is designed to be recyclable and have recyclable content and the Starbucks Company does its best to provide recycling bins in all its stores, this would have a positive impact on the environment as the polypropylene cups could be redesigned for other products instead of new raw material being used.

7.5 Recommendation and discussion

After analysing the Starbucks reusable cup from various dimensions such as behaviour and intention, attributes and environmental impact, there are some recommendations that the author came up with through comparing the Starbucks reusable cup with the results from the previous chapters. These recommendations can help the Starbucks Company to reach its goals and improve the reusable cup and the area surrounding it, as follows:

- Availability of recycling bin and reusable cup in stores.

As Starbucks seeks to increase the recycling facilities in its stores through implementing Back-of-store recycling and Front-of-store recycling, it needs to make more effort to meet its goal of having 100% recycling bins in stores by the end of 2015. Moreover, as was noticed during the case study, the reusable cup was not available in all stores, which requires more concentration on its availability in each store in order to increase knowledge about the cup and make potential users more eager to learn about or try this cup.

- Increasing knowledge about the reusable cup, which is achievable through programmes, advertising, and competition amongst societies.

The Starbucks Company should educate users about the importance of saving the environment by demonstrating the current issues and amount of trash going to landfill every year. Then, the Starbucks Company should advertise about its reusable cups more in order to increase the knowledge and awareness about the new packaging design. This initiative will produce a number of advertisements that customers will notice everywhere they go.

- Increase the influence of norms from friends, parents and relatives.

This is achievable by running competitions amongst customers in order to increase the influence on non-users of the Starbucks reusable cup from their friends, relatives and parents who participate in this competition, as Pizza Hut did for its reusable box, which was called the ‘green box’.

- In packaging attributes, add three more attributes which could lead to increase the number of users of the Starbucks reusable cup.

The analysis and discussion in previous sections about the Starbucks reusable cup attributes compared it with the reusable packaging attributes checklist. There are three more attributes that Starbucks should add to the packaging:

- Environment communication (labels, instruction for post-consumer): the Starbucks reusable cup should inform consumers about how the reusable cup can save the environment and how many trees can be saved if the customer uses it. This information should be presented in an attractive manner.
- Instructions: the Starbucks reusable cup should guide consumers on how to reuse it in terms of the best way to clean it and some advice on how to store it, how many times the customers can reuse it, is there any restriction about the type of drink that could not be used in these cups, etc. These instructions should be in plain language and clearly presented in order to assist the consumers.
- Incentives/rewards for use: the Starbucks Company should provide effective communication to users in order to encourage them to use the reusable cup, such as the rewards that come from saving money and announcing via social media the names of the customers who are helping to conserve the environment through certain activities.

7.6 Summary

This chapter has used the Starbucks reusable cup as a case study to validate the conceptual framework of the research. The chapter has shown how the Starbucks Company seeks to increase demand for its reusable cup rather than for a disposable cup, which led the author to find out the current situation regarding users' behaviour and intentions towards the reusable cup and then analyse the reusable cup attributes by matching them with the reusable packaging attributes checklist. Lastly, the research investigated how the Starbucks Company claims that it has designed the reusable cup to have a low environmental impact. Furthermore, there are many recommendations revealed which can be beneficial for Starbucks to take into consideration in order to reach its goal of promoting the use of its reusable cup. After conducting this case study on the Starbucks Company, the author can confirm that the proposed framework can be used in any industry that uses reusable packaging or that desires to implement reusable packaging in its business. The proposed framework can give some suggestions about the best areas to concentrate on amongst users in order to enhance reuse amongst societies. Also, the proposed framework can give some guidelines about how to enhance designing reusable packaging in industries with advice on how that can have an

environmental impact, which opens up opportunities for using innovative techniques to design reusable packaging .

CHAPTER 8: Conclusions and suggestions

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 increasing amount of waste packaging can have a direct impact on a nation's environment in terms of materials. 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 (see Chapter 1).

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 research designed a conceptual framework which contributed to enhancing reusable packaging amongst consumers and industries. From the conceptual framework, it was possible to identify major externally and internally driven variables (i.e. social behaviour, reusable packaging attributes and environmental impact of reusable packaging) (see Chapter 3).

In order to cope with enhancing reusable packaging amongst societies and industries, a general structure was developed and an appropriate research methodology was defined. The proposed research methodology was used to analyse and handle each phase of the enhanced reusable packaging framework (see Chapter 3).

The first phase of research was about the consumers' behaviour and intentions towards reusable packaging. The main aim of this phase was to study the effectiveness of improving social aspects that lead to the increased reuse of packaging in a short time period. The SD method offered a means by which to highlight the dynamics and interrelationships among the different social aspects in reusing packaging through CBT and TOPB in order to design a model. The model was initially applied through a group

of people to determine the relationship between consumers' intentions and behaviour towards reusable packaging. The results showed that it is important to focus on having a high level of knowledge about reusable packaging amongst society. The community should cooperate with industry to enhance personal and social values as well as social norms during designing reusable packaging. Also, the results found a direct connection between social norms and personal and social values if there is effort concentrated on developing behaviour control. For this reason, SD as a decision-making tool was found to be a useful method for discovering the relationship between the multi criteria of social aspects and reusable packaging practice. Additionally, the SD method was found to be a useful analytical tool for finding out which factors are the most influential in the whole process (see Chapter 4). This phase contributes to enhance packaging reuse amongst society.

The next phase of the research was about discovering the attributes of reusable packaging. This phase determined reusable packaging's attributes in relation to consumers' orientation. An integrated approach was used to identify packaging attributes. Quantitative research was conducted amongst experts in the field of packaging to develop and test the design packaging attributes' relationship to the reusable packaging attributes identified in the literature. Also, qualitative research was conducted amongst consumers to identify packaging attributes from packaging used for secondary uses using a questionnaire. The result of this phase was a reusable packaging attributes checklist, which can be used as guidance on how to effectively apply reusable packaging thinking to non-reusable packaging. Additionally, the reusable packaging attributes checklist will be useful for designers/manufacturers to interpret the 'BS En 13429:2004 reuse of packaging' standard (see Chapter 5).

The next phase of the research was about finding out the environmental impact of reusable packaging. The research used the reusable packaging attributes to discover the relationship between environmental impact and reusable packaging. Factor analysis with principal component analysis was used to help cluster a group of attributes and its impact on the environment. The results of this phase have updated the reusable packaging attributes checklist to be more valuable and have provided information about the level of environmental impact of designing reusable packaging (see Chapter 6). The second and third phases contribute to enhance packaging reuse amongst industries.

The last phase of the thesis was the conduction of a case study in order to validate the thesis results. The case study focused on Starbucks and its attempts to increase the number of users of its reusable cup. Starbucks faces the challenge to increase the number of reusable cup users by 5% by the end of 2015. The research applied SBAM and a reusable packaging attributes checklist in this case and came up with some suggestions and advice for the Starbucks Company to help it increase the number of users of its reusable cup. This case study contributes to confirm and elaborate on the results found in the previous chapters, which boosts the importance of the framework and its implementation amongst industries (see Chapter 7).

8.1 Contribution to knowledge

The main contribution of the research is the creation of the enhanced reusable packaging framework, which includes SD and reusable packaging attributes checklist. This research opens opportunities for improving packaging to meet sustainable profits. It provides valuable information based on social, economic and environmental benefits of reusable packaging. It is a holistic piece of research with relevant tools and techniques, enabling the industries to facilitate the process-based change effectively at any point. The implementation of research provides a logical and organised procedure.

Moreover, management research is the systematic and objective process of gathering and analysing data for improving managerial decision-making. The discussion of the results in the light of the theory and practice has enabled the author to determine the implementations of the research. The research has established important findings and suggestions on enhancing reusable packaging, which will be valuable to the decision-making process in the packaging industry. 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, reusable packaging attributes and the environmental impact of reusable packaging. The proposed SD model is in fact an objective way to handle subjective information in increasing the use of reusable packaging. This can help industries to take corrective and preventive actions at early stages to overcome the weaknesses. Additionally, the main managerial implication of the research, which involves the reusable packaging attributes checklist, is to help industries regarding how to effectively apply reusable packaging 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. In addition, the reusable packaging attributes checklist includes a description of the environmental impact of reusable packaging attributes. This gives the opportunities for manufacturers to think carefully during implementing these attributes.

8.2 Suggestions for further research

The research has achieved its aim of proposing an integrated method to reduce environmental impact from waste packaging and to increase knowledge on the best way to enhance reusable packaging. Although it is not claimed to be a definitive method, it can play a valuable role as a methodology for increasing reusable packaging. Several important issues have been analysed in this research; however, other issues could not be incorporated due to the scope, time constraints and because the research has prominently been exploratory. The aspects that were not covered in detail are part of the suggestions for further work that should be pursued. In this respect additional research seems therefore to be needed on the following aspects:

The SD model to investigate consumers' behaviour and intentions towards reusable packaging could be extended to incorporate other social perspectives such as social demographics, personal values of frugality, environmental attitudes and policy perceptions. Some of the predictors used in the proposed model should also be considered further. For instance, personal values could encompass other personality features that are measured by additional observed variables, and specific behaviour control could include items assessing how knowledgeable respondents are about the behavioural benefits of reusing packaging, and examining the relationship between environmental attitudes and pro-environmental behaviours on reusing packaging. In the awareness stage, there are some factors that should be determined such as maximum awareness-changing time, which is the average length of time it takes for people to become aware about packaging reuse. In addition, minimum awareness-changing time is the shortest time required for a person with lots of influences around to become aware. Similarly, in the adaptation stage, there are some factors that could be included, such as minimum behavioural adaptation and maximum behavioural adaptation.

With regard to the reusable packaging attributes checklist, further studies should be carried out on how to measure these attributes and how to determine the reusable packaging performance in order to compare it with one-way packaging in various dimensions such as logistics, sustainability, marketing, geometry and safety. It is clear that investigation into these dimensions needs to be addressed in order to integrate packaging performance through identifying the total packaging performance index.

Moreover, it is generally difficult to identify the environmental impact of reusable packaging attributes in general because there are different types of packaging that often have substantially different boundaries and conditions. These reusable packaging attributes may increase the environmental impact of the new reusable packaging design. Hence, in order to make the results of this study more useful to the packaging industry, it is important to conduct more research into how to reduce the environmental impact in each attribute, such as what are the best types of materials or techniques which can be used to meet the reusable packaging attributes and at the same time reduce the environmental impact.

In addition, life cycle assessments of the life cycle of reusable packaging are desirable in order to generate optimal reusable packaging strategies and to assess how to achieve reusable packaging through waste management systems. In addition, it is time to investigate the suitable regulations that could be set up for industries and societies to boost reusable packaging.

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APPENDIX I: Model assumptions, Parameters, Variables units in the system dynamic model.

The model assumption is 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 increasing the influence of the latter in the area. This area depends on the total number of practitioners versus people uninformed about packaging reuse.

The main model parameters are: people informed about packaging reuse, people aware about packaging reuse and practitioners in packaging reuse for the three parts of CBT and all the model variables with its units are presented in the Table below:

Name	Units
People uninformed about packaging reuse	Person
People Informed about packaging reuse	Person
People Aware about packaging reuse	Person
Practitioners in packaging reuse	Person
Awareness-changing rate	Person/ Day
Behavioural Adaptation rate	Person/ Day
Information rate	Person/ Day
Time rate	Day
Total population influence	Person
Total population	Person
Practitioners' prevalence	Dimensionless
Practitioner with people uninformed about packaging reuse	Person
Perceived knowledge	Person
Personal and social values	Person
General environmental concerns	Person
Influence from friends' norms	Person
Influence from relatives' norms	Person
Better condition of product packaging	Person
Perceived convenience	Person
Personal values	Person
Social values	Person

Money benefits	Person
Social cost	Person
Awareness of consequences	Person
Awareness of environmental issues	Person
Awareness of environmental values	Person

APPENDIX II: Questionnaire used in Survey 1 for the purpose of Chapter 4

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23 March 2013

To WHOM IT MAY CONCERN

A research project at Liverpool John Moores University is currently being carried out with regard to developing a solid waste management system and it is specifically looking at the environmental Impact Modelling and Optimisation of Waste Packaging. This subject will become a critical topic in the international agenda due to the fast expansion of the density of population in countries and the global economic recession over the past decade.

The research aims to investigate the relationship between environmental impact and the reuse of waste packaging as a means to tackle the amount of waste, in order to increase knowledge regarding the best way to improve the sustainability of packaging. One of the objectives in the research is to investigate social factors including consumers' behaviours and consumers' incentives in order to identify consumer's orientation that increase an environmental responsibility response among the society, which are the key elements of the proposed framework. This will be delivered by this questionnaire after applying the system dynamic modelling method.

A number of evaluation criteria have been determined in this research. All the evaluation criteria need to be measured. A questionnaire is enclosed with this letter.

I should be most grateful if you could kindly spare your valuable time to complete the accompanying questionnaire. Your vital feedback will greatly benefit and contribute to the formulation of an industry-wide opinion. I can assure you that the confidentiality of your response will be honoured and respected.

Yours faithfully,

Eng. Ahmed B. Babader
PhD researcher, School of Engineering
Liverpool John Moores University

Please take a few moments to complete this survey. Your responses will help us to address any issues that you may have as well as to better target products to meet your needs and be environmentally friendly. Your responses will be kept confidential. Please circle the suitable answer in the relevant boxes.

Part 1 Social Demographic:

Age:	***Under 20***	***21-30***	***31-40***	***Over 41***
Gender:	*Male*	*Female*		
Number in family:	*Only 1 people*	*2-5*	*6-8*	*9 people or more*
Education Level:	*No Education*	*School*	*Bachelor*	*Master*$^{+}$
Job Level:	*Beginning employee*	*Middle employee*	*high employee*	*Senior employee*
Years of residence in the community:	1-3 years	4-7 years	8-11 years	over 12 years
Personal behaviour towards waste:	Recycling	Composting	Reduce	Nothing
Product reused	Glass	Clothes	Steel	Other

Part 2 General Behaviour:

Questions	Never	Rarely	Occasionally	Frequently	Very Frequently
I reuse my waste packaging for original use.					
I reuse my waste packaging for other uses.					
I am committed to reuse my waste					

Part 2 General Attitudes:

Questions	Strongly Disagree	Disagree	Undecided	Agree	Strongly Agree
I reuse packaging because of add value to me.					
I reuse packaging because it creates pleasant feelings.					
I am not reuse waste packaging because is meaningless.					
I reuse waste packaging because it is a good tackle for waste packaging before disposal.					

Part 3 Subjective Norms:

Questions	Never	Rarely	Occasionally	Frequently	Very Frequently
I feel a strong personal obligation to reuse waste packaging because my parents do.					

My parents expect me to reuse waste packing.
Importance of parents' pressure as a reason for me to reuse waste packaging.
I feel a strong personal obligation to reuse waste packaging because my relatives do.
My relatives expect me to reuse waste packing.
Importance of relative's pressure as a reason for me to reuse waste packaging.
I feel a strong personal obligation to reuse waste packaging if my friends do.
My friends expect me to reuse waste packing.
Importance of friend's pressure as a reason for me to reuse waste packaging.
I would feel guilty because I did not reuse my waste packaging.
I want to reuse waste packaging because organization environmental protections expect me to do.
I want to reuse waste packaging because government expect me to do.

Part 4 Perceived behaviour control:

Questions	Totally false	Partially false	Undecided	Partially true	Totally true
I reuse my waste packaging because there are many products packaging could be reused.					
I reuse my waste packaging because it is clean to reuse or easy to clean.					
I reuse my waste packaging because it is easy to store.					
I reuse my waste packaging because it is safe to reuse.					
I reuse my waste packaging because I received information about how to reuse waste.					
I reuse my waste packaging because I received information about whole reuse waste process.					
I reuse my waste packaging because I received support and customer service.					

I reuse my waste packaging because it is convenient to my social lifestyle.					
I do not have time to think on how to reuse waste packaging.					
I not reuse my waste packaging because it is very difficult task.					
I reuse my waste packaging is entirely up to me.					

Part 5 Perceived knowledge about reuse packaging:

Questions	Totally false	Partially false	Undecided	Partially true	Totally true
I know when I can reuse my waste packaging.					
I know how many time should I reuse my waste packaging.					
I know how to get rid of packaging after several times reuse.					
I have received information about waste packaging reuse through TV.					
I have received information about waste packaging reuse through radio.					
I have received information about waste packaging reuse through newspapers.					

Part 6 Perceived personal and social values:

Questions	Totally false	Partially false	Undecided	Partially true	Totally true
I reuse my waste packaging because I found that I accomplish something important to society.					
I reuse my waste packaging because I found money benefits.					
I reuse my waste packaging because it affects my children behaviour.					
I reuse my waste packaging because it saves natural resources.					
I reuse my waste packaging because it reduces environmental pollution.					
I reuse my waste packaging because it is an important way to conserve energy.					
I reuse my waste packaging because it reduces lavishness.					
I reuse my waste packaging because it reduces social cost.					
I reuse my waste packaging because it reduces the load on waste management system.					

I reuse my waste packaging because it emerges my participation among society.					

Part 7 Awareness about environmental concern:

Questions	Totally false	Partially false	Undecided	Partially true	Totally true
I reuse my waste packaging because participation on waste packaging reuse will help the reduce environment impact.					
I reuse my waste packaging because we must live in harmony with the nature to survive.					
I reuse my waste packaging because the nature is very delicate and easy to upset.					
I reuse my waste packaging because the humans are severely abusing the environment.					
I reuse my waste packaging because environmental dilemma.					

APPENDIX III: Questionnaire used in Survey 2 for the purpose of Chapter 5

Questionnaire for the classification of criteria and sub-criteria on Attitudes of Reusable Packaging (ARP) to enhancing reusable packaging production

A research project at Liverpool John Moores University is currently being carried out with regard to developing a solid waste management system and it is specifically looking at the environmental Impact Modelling and Optimisation of Waste Packaging. This subject will become a critical topic in the international agenda due to the fast expansion of the density of population in countries and the global economic recession over the past decade. This section of research will discover reusable packaging attributes that are environmentally responsible, socially benefits and economy profits. These attributes can reduce waste, improve energy efficiency, limit toxic by-products, contain recycled content in the end life, meeting customers' needs/expectations and achieving market differentiation. The goal of this study is to identify the most effective attributes that influences people/companies to implement reusable packaging. Therefore, the criteria and sub-criteria listed in Table 1 are the parameters that need to be classified by experts to determinate the core, supplemental and correlating reusable packaging attributes using "*Normal Average*" technique. Answers to this questionnaire may assist us in writing attributes that are both relevant to manufacture sectors and fair to respective markets and can be guidelines for designers, manufactures and business to implement reusable packaging in products. There is no any standard investigating reusable packaging attributes deeply and classified into main three groups: core, supplement and correlation attributes. However, European standard 'EN 13429:2004 reuse of packaging' outlined the procedures for assessing the packaging to conformity with requirements of reuse systems without detail the design features. Your response to this questionnaire is appreciated. Information submitted will not be used to evaluate, rank or select vendors or products, nor will it be used to pre-qualify or screen vendors for a subsequent competitive bidding process. All responses to this questionnaire will be held in confidence. Respondents to this questionnaire consent to incorporating any submitted information into any specification without any obligation, liability, or consideration on the part of the research. This study has received ethical approval from LJMU's Research Ethics Committee (13/ENR/003).

Study author:

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Criteria	Sub-criteria
Geometry/Ergonomic	Refill ability with other product Clean ability (content) Portability Restore ability Re-seal ability Easy ability to open and re-close (quick to use) Packaging characteristics (weight, dimension and material, colour, print quality, size) Endurance Packaging mass and shape
Sustainability	Packaging design and materials type Environment communication (labels, instruction for post-consumer) Costs Recycling contents Hygiene or easy to disinfected Meet consumers' needs Safe materials Post-consumer recycling Hold content safety Less waste
Marketing communication	Quality and value of packaging Availability of support or services for reuse Incentives/rewards for use Instructions (product and marketing information and ways to reuse packaging) Convenience to use

To proceed with the "*Normal Average*" technique, an expert has to understand the ratio scale measurement used in this study. The criteria measured on 5 Likert scale related to its importance into reusable packaging attributes as following:

1. **Main criteria**

In your experience, what extent do you think these dimensions are important to producing reusable packaging?

	Very Important	Important	Neutral	Unimportant	Very Unimportant
Geometry/Ergonomic					
Sustainability					
Marketing and communication					

2. Sub-criteria

Geometry/Ergonomic

Regarding to geometry/ergonomic dimension, what extent do you think these factors are important in terms of social perspective to producing reusable packaging?

	Very Important	**Important**	**Neutral**	**Unimportant**	**Very Unimportant**
Refill ability					
Clean ability					
Portability					
Restore ability					
Re-seal ability					
Easy ability to open					
Packaging characteristics (weight, dimension and material, colour, print quality, size)					
Endurance					
Hold content safety					
Packaging mass and shape					
Safe materials					

Sustainability

Regarding to sustainability dimension, what extent do you think these factors are important in terms of environment, economic and social (in consumers' perspective) to producing reusable packaging?

	Very Important	Important	Neutral	Unimportant	Very Unimportant
Packaging design characteristics and materials type					
Environment communication (labels, instruction for post-consumer)					
Recycling contents					
Less waste					
Costs					
Hygiene or easy to disinfected					
Meet consumers' needs					
Post-consumer recycling					

Marketing communication

Regarding to marketing communication dimension, what extent do you think these factors are important to producing reusable packaging?

	Very Important	Important	Neutral	Unimportant	Very Unimportant
Instructions (product and marketing information and ways to reuse packaging)					
Quality and value of packaging					
Availability of support or services for reuse					
Incentives/rewards for reuse					
Convenience to use					

If you have any comments about the questionnaire for research project, please indicate here	

APPENDIX IV: Questionnaire used in Survey 3 for the purpose of Chapter 5

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13 July 2013

To WHOM IT MAY CONCERN

My name is Ahmed Babader and I am a PhD student on the Liverpool John Moorse University in engineering department. You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

I am carrying out an expletory study about waste packaging in terms of reduce environmental impact of waste packaging and what influences the overall amount of waste packaging if we introduce multi-purposes packaging. The research title is: Environmental impact modelling and waste packaging optimization. This part of a research concentrates on effectiveness of multi-purpose packaging in reduction of environmental issues by completing this online anonymous questionnaire. This questionnaire is looking for identification type of packaging that people reused for different purposes. For example, you are buy cheese with glass packaging, then after you finished, you reused glass packaging for store anything else as illustrated in figure.

If you could have a look on your house and find any type of these packaging that you are reused for other purpose, then make a photo of this packaging and attach it to me by link below, with the name of product and why you reused this packaging?

http://www.formpl.us/form/0B7WRjDCigtQ-WUNqRXBPMF9yVVE

The results of this research will be used in further investigation. The results of the research will be present as thesis and you may able to find it in Liverpool John Moorse university library. Any participants will not be identified in any report or publication. Your answers will be treated with complete confidentiality. Your participation is entirely voluntary and you are free to stop taking part at any time. A decision not to participate will not affect your grades in any way.

If you have any questions about this questionnaire or research project, please contact me at a.b.babader@2011.ljmu.ac.uk.

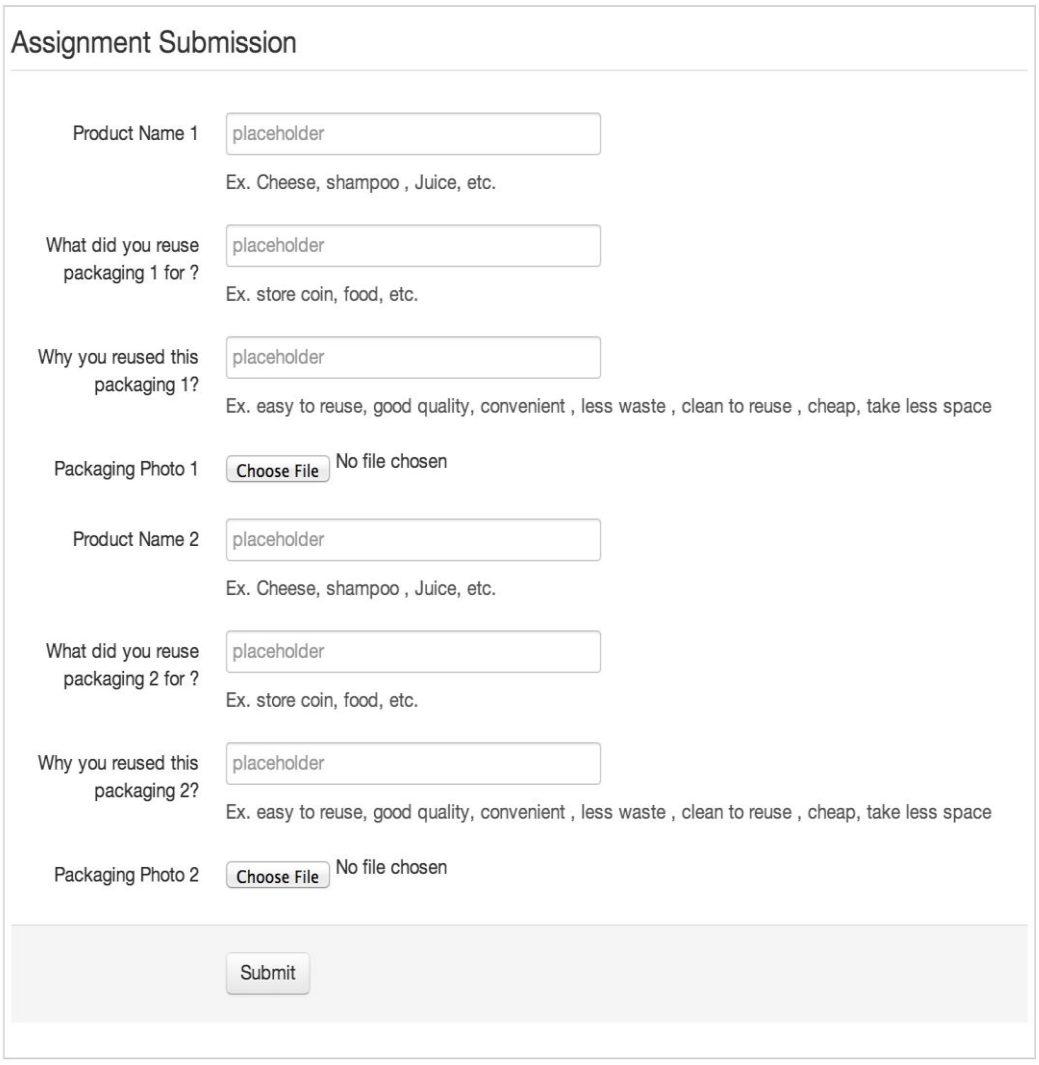
Thank you very much for your time.

Yours faithfully

Ahmed Bader Babader
PhD researcher, School of Engineering

APPENDIX V: The attachment form in Survey 3

The questionnaire:



APPENDIX VI: Summary of Secondary Packaging reuse

packaging example	Product name	Reused for	packaging example	Product name	Reused for
	Olive bottle	Store tea		Quality Street Box	Holds my chemicals
	Tomato Paste	Store sauce		Guess Wristlet bag box	Hold purse
	Baby milk box	Coal keeper		Clarks Shoe box	Holds my nail stuff

	Delivery box	Hold my creams and oils		Sony Ericsson phone box	Collection of old memories
	Honey pot	Eye makeup		Yaren bottles	Holds nuts
	Olay Creams	Strong plastic protects the jewellery from scratching		Olive and other glass bottles	Holds seasonings and herbs

	Hush Puppies shoe box	CDs collection box		Pure DKNY perfume box	Hold my makeup and creams
	Cheese	Medications		Indonesian noodles box	Keep plastic stuff
	Jam bottle	Sugar and Olive scrub		Apricot jam	Save pepper sauce

	Pens bag	Hold keys		Toy gift box	Store toys
	Mobile box	Saving wires		Jam bottle	Keep Curcuma
	Cotton Buds	Colour holder		Gram	Chili sauce

APPENDIX VII: Questionnaire used in Survey 4 for the purpose of Chapter 6

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17 March 2014

To: WHOM IT MAY CONCERN

A research project at Liverpool John Moores University is currently being carried out to explore about waste packaging in terms of reducing environmental impact of waste packaging and what influences the overall amount of waste packaging if we introduce reusable packaging. This part of a research concentrates on effectiveness of implementing reusable packaging in the decrease of environmental issues by completing this attached anonymous questionnaire. This questionnaire is looking for identifying the relationship between reusable packaging attributes and environmental impact factors.

My name is Ahmed Babader and I am a PhD student on the Liverpool John Moores University in engineering department. I am inviting you to contribute to this research study by completing the attached surveys. Thank you for taking the time to assist me in my educational endeavours. The following questionnaire covers the third part of the research (Environmental impact modelling and waste packaging optimization) and the questionnaire will require approximately 10 minutes completing. There is no compensation for responding nor is there any identified risk. If you choose to participate in this project, please answer all questions as honestly as possible. Any participants will not be identified in any report or publication. Your answers will be treated with complete confidentiality. Your participation is entirely voluntary and you are free to stop taking part at any time. A decision not to participate will not affect your grades in any way. The results of the research will be present as thesis and you may able to find it in Liverpool John Moorse university library.

If you require additional information or have questions, please contact me at the addresses listed below. This study has received ethical approval from LJMU's Research Ethics Committee (13/ENR/003- 09/October/2013

Yours faithfully

Ahmed Bader Babader
PhD researcher, School of Engineerin

The goal of this questionnaire is to discover the most importance **reusable packaging attributes**. Therefore, the reusable packaging attributes groups listed in Table 1 are the parameters that need to be evaluated by using principal factor analysis as this the importance method to determinate the weight of these attributes. Based on your experience in this field, I'd like you to use the Five-point likert's scale to evaluate to what extent each group affect each of the environmental impact factors in three

dimensions. Where 1- No Impact, 2- very low Impact, 3- low Impact, 4- high Impact and 5- very high Impact.

Table 1

Groups	Attributes
Health care group	Clean ability (content) Hold content safety Safe materials Packaging mass and shape Packaging characteristics (weight, dimension and material, colour, print quality, size)
Ergonometric (engineers) group	Refill ability with other product Restore ability Re-seal ability Easy ability to open and re-close (quick to use) Endurance
Environment group	Environment communication (labels, instruction for post-consumer) Recycling contents Less waste
Social group	Hygiene or easy to disinfected Meet consumers' needs Costs Post-consumer recycling
Economic group	Packaging design Materials type Costs
Marketing group	Quality and value of packaging Availability of support or services
communication group	Instructions (product and marketing information) Incentives/rewards for use Convenience to use

For example:

If you are asking to evaluate the pop starts performance based on your opinion, what extent each pop start have perform in various aspects, where 1- Too bad, 2- Bad, 3- Fair, 4- Good and 5- very good.

	Innovative	Quality	Speed	Time	consistency
Pop starts	5	3	3	4	1

Part 1: Environmental condition - Resources

The purpose of this section of the questionnaire is to evaluate the relationship between the 'Reusable-Packaging Attributes' and the 'Resources environmental impact'. Based on your experience in this field, I'd like you to use the Five-point likert's scale to evaluate to what extent each group affect each of the resources environmental impact factors, where 1- No Impact, 2- very low Impact, 3- low Impact, 4- high Impact and 5- very high Impact.

	Environmental condition indictors

	Recourses					
	Primary energy	Net energy	Fossil fuel consumption	Oil and gas use	Electrical use	Raw material use
Health care group						
Ergonomist (engineers) group						
Environment group						
Social group						
Economic group						
Marketing group						
communication group						

Part 2: Environmental condition – waste

The purpose of this section of the questionnaire is to evaluate the relationship between the 'Reusable-Packaging Attributes' and the 'Waste environmental impact'. Based on your experience in this field, I'd like you to use the Five-point likert's scale to evaluate to what extent each group affect each of the waste environmental impact factors, where 1- No Impact, 2- very low Impact, 3- low Impact, 4- high Impact and 5- very high Impact.

	Photochemical oxidants	Acidification	Eutrophication	Air pollution	CO2 emissions	Effluents	Toxic wastes	Hazardous wastes	Water quality	Water quantity
Health care group										
Ergonomist (engineers) group										
Environment group										
Social group										
Economic group										
Marketing group										
communication group										

Part 3: Global condition

The purpose of this section of the questionnaire is to evaluate the relationship between the 'Reusable-Packaging Attributes' and the 'Global condition'. Based on your experience in this field, I'd like you to use the Five-point likert's scale to evaluate to

what extent each group affect each of the waste environmental impact factors, where 1- No Impact, 2- very low Impact, 3- low Impact, 4- high Impact and 5- very high Impact.

	Global condition		
	Global warming	Greenhouse gas emissions	Climate change
Health care group			
Ergonomist (engineers) group			
Environment group			
Social group			
Economic group			
Marketing group			
communication group			

APPENDIX VIII: Questionnaire used in Survey 5 for the purpose of Chapter 7

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25th April 2014

To: WHOM IT MAY CONCERN

This questionnaire is intended to provide information for a project currently being carried out at Liverpool John Moores University with regard to developing a solid waste management system, which is specifically looking at the environmental impact modelling and optimisation of waste packaging.

The research aims to investigate the relationship between customers' behaviours and intention towards using Starbucks reusable cup as a means to reduce the amount of waste packaging, in order to increase knowledge regarding the best way to improve use of reusable packaging. One of the objectives in the research is to investigate social factors including consumers' behaviours and incentives in order to identify how to increase environmentally responsible responses from society, which is the key element. A number of evaluation criteria have been determined in this research, all of which need to be measured through the questionnaire enclosed with this information sheet.

I should be most grateful if you could kindly spare your valuable time to complete the accompanying questionnaire. Your vital feedback will greatly benefit and contribute to increasing use Starbucks reusable cup. I can assure you that the confidentiality of your response will be honoured and respected. If you have any queries regarding this research, please do not hesitate to contact me.

Yours faithfully,

Ahmed B. Babader

Part 1: Norms

* Please select the relevant option from each of the questions below.

Have you ever used a Starbucks reusable cup? *

Yes

No

In this section, you will evaluate the norm that encourages you to use a Starbucks reusable cup.
Please choose the most suitable answer. *

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I feel a strong personal obligation to use a Starbucks reusable cup because my parents/relatives/friends do.					
I would feel guilty if I did not use a Starbucks reusable cup.					
I want to use a Starbucks reusable cup because organisation/government environmental protection agency expects me to do so.					

Part 2: Perceived knowledge about the Starbucks reusable cup

In this section, you will evaluate the knowledge you have about the Starbucks reusable cup and the support you have been given in order to influence your intention to use it.
Please choose the most suitable answer. *

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I know how to dispose of the Starbucks reusable cup.					
I have received information about using the Starbucks reusable cup via Starbucks/TV/radio/newspapers/social media.					

Part 3: Perceived personal and social values

In this section, you will evaluate the personal and social values that influence your intention to use a Starbucks reusable cup. Please choose the most suitable answer. *

	Strongly agree	agree	Neutral	Disagree	Strongly disagree
I use a Starbucks reusable cup because I feel that by doing so I accomplish something important to society.					
I use a Starbucks reusable cup because there are financial benefits for doing so.					
I use a Starbucks reusable cup because it presents a good model for my children.					
I use a Starbucks reusable cup because it saves natural resources, reduces environmental pollution and is an important way to conserve energy.					
I use a Starbucks reusable cup because it reduces waste handling costs.					
I use a Starbucks reusable cup to indicate my environmental awareness.					

Part 4: Awareness about environmental concerns

In this section, you will evaluate your awareness about environmental issues that influence your intention to use a Starbucks reusable cup. Please choose the most suitable answer. *

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I use a Starbucks reusable cup because doing so will help to reduce environmental impact of disposal of waste materials.					
I use a Starbucks reusable cup because we must live in harmony with nature to survive.					
I use a Starbucks reusable cup to reduce the negative behaviour of human practices.					
I use a Starbucks reusable cup to reduce environmental issues from packaging.					

Part 5: Reusable cup attributes

In this section, you will evaluate some of Starbucks reusable cup attributes that influence your intention to use a Starbucks reusable cup. Please choose the most suitable answer. *

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Starbucks reusable cup characteristics (such as weight, dimension, colour, print quality, size)	○	○	○	○	○
Starbucks reusable cup design.	○	○	○	○	○
Meet your needs.	○	○	○	○	○
Incentives/rewards for use Starbucks reusable cup.	○	○	○	○	○
Convenience to use Starbucks reusable cup	○	○	○	○	○

Finally: Personal information

What is your gender? *

☐ Male

☐ Female

What is your age? *

☐ Under 20

☐ 21-30

☐ 31-40

☐ 41 and above

What is your education level? *

○ No Education

○ School

○ Bachelor's degree

○ Master's degree

○ Other – please state

What are the extra functions that you suggest to add in the Starbucks reusable cups?