Green Packaging

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I hereby declare that the work submitted is mine and that where I have made use of another's work, I have attributed the source(s) according to the Regulations set in the Student's Handbook.

December 2016
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Abstract

This dissertation was written as part of the MSc in Strategic Product Design at the International Hellenic University.

Packaging is of great importance, since it is the first level of communication between a product and the consumers. Packaging is significant, since it has the following functions: effective medium of marketing having an effect upon the purchasing decision of consumers, it enables the transportation, delivery, and bulk handling of the products, protects the product from influences of the external environment and its exposure to factors that can cause contamination for the benefit of consumers’ health and safety, and influences consumer behaviour with regard to green practices. Nowadays, consumers are more aware of the environmental problems and require from the companies to adopt packaging process, which is eco-friendly, and which takes into account the issue of their safety. Thus, companies are forced to invest in new, innovative and sustainable package materials, as for example chitin nanowiskers, plant-based, renewable packaging materials and agricultural waste. Overall, the sustainability in the package design, namely the green package design, should govern all its three stages, production, distribution, and consumption. However, there is also a need to incorporate in this green thinking not only innovative and environmental friendly package materials, but also innovative and eco-friendly package design. This could be the issue of a further research.

At that point, I would like to thank my supervisor Dr. Charisios Achillas who gave me guidance throughout the time that I was working on my dissertation. All that knowledge he gave me was more than supportive and it made me end up with the right conclusions. Moreover, I would like to mention that the sense of teamwork was of high importance to me and my colleagues and gave us the opportunity to learn how to cooperate and collaborate with each other. Last but not least, I am very grateful to have the support of my family and my friends at this academic year.

Keywords: packaging, sustainability, consumers, material

Giorgos Dellis

December 2016
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INTRODUCTION

Packaging is regarded as the fifth element, or better the fifth ‘P’, of the marketing mix, because of its importance in the communication with consumers, in building relationship with them, in influencing their purchasing decisions, the promotion of the products and the brand values, as well as in differentiating a product (company) from the competitors (Ford et al., 2012; Magnier and Schoormans, 2015).

In addition, packaging has an impact on the nutrition aspects of the products, due to the interaction of the products’ compounds with the packaging material (Eilamo et al., 1998). Some packaging materials may result in the development of bacteria, which may cause severe human infections (Nakazato et al., 2017). However, packaging is important for the preservation and storage of the products, as well as for its transportation across the supply chain and its disposal to the end-consumers (Magnier and Schoormans, 2015; van Herpen et al., 2016).

Thus, modern packages should be appealing, and safe at the same time, especially due to the fact that consumers require from the companies to adopt an eco-friendly process, and to be offered products that can be consumed without delay and without negative effects for their health (Lamberti and Escher, 2007). From this point of view, sustainable packaging can be an important tool for obtaining a competitive advantage, building and communicating brand value, and influencing consumer behaviour (Delgado et al., 2013; Jerzyk, 2016). Besides, it is supported that innovation in sustainable packaging, or else eco-packaging, is an important strategy in building brand loyalty and attracting consumer preference (Jiménez-Guerrero et al., 2015). Thus, consumers may be motivated to buy products that are safe for the environment, based on their environmental concerns. For this reason, an effective sustainable packaging, which means a combination of an effective design and environmental messaging, has an impact on consumer behaviour, helping the companies to obtain a competitive advantage, not only for the product, but also for the brand (Jerzyk, 2016).
From the above it can be supported that packaging serves three distinct functions (van Herpen et al., 2016): a) information and communication; b) protection and preservation; c) containment and handling. Within the same context, Pathak (2014) argues that package serves many functions: a) preserving the product from damages during distribution and storage; b) providing information to consumers about the content of the product; c) influencing consumers’ purchasing decisions; d) contributing to the creation of loyal customers, building a brand, and differentiating for the competitors’ products.

What should be taken into account, however, is that consumers are today more aware of environmental protection concerns, and thus they demand the use of eco-friendly packaging. Moreover, due to the fact that some packaging material may be harmful for the public health, innovations are being made towards this direction, in order to discover new packaging material that are friendly not only to environment, but also to consumers’ health. Based on the fact that “packaging has a vital social and economic function”, it is “subject to various legislative requirements related to the quality, safety and hygiene of packaged products: requirements for the transport of dangerous goods; regulations concerning packaging in contact with foodstuffs; measures dealing with the environmental aspects of packaging and packaging waste” at a European level (CEN, 2016).

The aim of the present study is to critically examine the above mentioned issues, namely the packaging process. More precisely, the objectives of this research are the following:

1. To present the importance of packaging
2. To discuss issues with regard to packaging materials, in relation to issues of public health and environmental protection
3. To identify the new packaging materials used by the companies, in order to address the issues of environmental and health concerns on behalf of consumers
Secondary research method will be employed for the purposes of this research. This means that this study will not be based upon a primary research, but it will be based on previous studies, official reports about packaging safety guidelines, and on the findings of other researchers. For this reason, articles from academic journals, online articles, official reports from governmental bodies, as well as books from the international bibliography will be used.
1. LITERATURE REVIEW

The aim of this chapter is to critically discuss the definition, system and life-cycle of packaging, the importance of packaging and its functions, the concept of sustainable packaging, the European Packaging and Packaging Waste Directive, as well as the emergence of new packaging materials.

1.1 Packaging definition, system and industry

According to Kotler, packaging can be defined as “all the activities of designing and producing the container for a product” (Pathak, 2014, p. 61). According to Manalili et al. (2014, p. 4), “packaging refers to the technology and material for enclosing or protecting products for distribution, storage, sale, and use”. Packaging is defined by two main factors: functionality and point of destination (Arikan, 2011). However, according to Fitzpatrick et al. (2012) packaging system is defined in terms of the role it serves at the various stages in the supply chain. Several types of packaging make up the packaging system. Usually, the packaging system consists of primary, secondary and tertiary packaging, as presented in the following figure.

![Packaging System Diagram](source)

**Primary packaging**

The pack that the consumers takes home

**Secondary packaging**

Inner cartons, trays, boxes. This includes retail-ready and display packaging

**Tertiary packaging**

The outer transport packaging, such as pallets and stretch wrap, that gets products to the depot or distribution centre

Figure 1. Packaging system (Source: Envirowise Guide, 2014, p. 27)
Primary, secondary and tertiary packaging are the main packaging system, or else the three primary packaging types. However, Saghir (2004) adds five more packaging types, as depicted in the following table.

<table>
<thead>
<tr>
<th>Packaging type</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary packaging, consumer packaging or sales packaging</td>
<td>Packaging which is in contact with the product. The packaging that the consumer usually takes home</td>
</tr>
<tr>
<td>Secondary packaging</td>
<td>Is designed to contain several primary packages</td>
</tr>
<tr>
<td>Tertiary packaging</td>
<td>Used when a number of primary or secondary packages are assembled on a pallet or roll container</td>
</tr>
<tr>
<td>Group packaging</td>
<td>Packaging which is conceived to facilitate protection, display, handling and/or transport of a number of primary packages</td>
</tr>
<tr>
<td>Transport packaging, industrial packaging, or distribution packaging</td>
<td>Packaging which is conceived to facilitate handling, transport and storage of a number of primary packages in order to provide efficient production and distribution as well as prevent physical handling and transport damage</td>
</tr>
<tr>
<td>Display packaging</td>
<td>Same as group packaging, quite often with an emphasis on display features</td>
</tr>
<tr>
<td>Retail packaging</td>
<td>Same as group packaging with a special emphasis on the design to fit in retail</td>
</tr>
<tr>
<td>Used packaging</td>
<td>Packaging/packaging material remaining after the removal of the product it contained</td>
</tr>
</tbody>
</table>

Source: Saghir, 2004, p. 7

Finally, the life-cycle of the packaging system is presented in the following figure. The importance of packaging life cycle in sustainable development was recently taken into consideration. In the previous years, companies, as well as governments and other public bodies, placed emphasis upon the last stage of packaging, namely the reduction of waste and the increase of recycle. However, the importance of packaging life cycle was finally acknowledged, as well as the interaction between product and package, which was a big step in the implementation of regulations (Fitzpatrick et al., 2012). In addition, the emphasis on packaging life cycle was important for the provision of information in terms of introducing sustainable packaging principles (Lewis, 2012), as it is going to be discussed in next section.
With regard to the packaging industry, it is distinguished into the demand and supply side, as depicted from the following figure. From the supply side, the package manufacturing has the greatest share in the packaging industry, followed by packaging service and finally packaging machinery.
Concerning the packaging demand, there are several factors that drive this side, as for example the synthesis of the world population, the increased consumers’ requirement for convenience, health and safety, the changing lifestyle towards the so-called on-the-go lifestyle, the companies’ requirement for differentiation and brand strengthening due to the intense competitive environment in which they operate, the developments in the materials used for package, the trend for smaller packages since people tend to eat alone and have smaller houses, the consumers’ concerns regarding the protection of the environment, as well as the regulation regarding packaging, use of renewable sources, and recycling (World Packaging Organization, 2008). The following figure presents the top three trends that affect the packaging market worldwide in 2015, as well as six more trends.

![Figure 4. Trends affecting packaging market (Source: Euromonitor International, 2015)](image)

1.2 Importance of packaging

Packaging is of great importance, since it is the first level of communication between a product and the consumers. It is regarded as an effective medium of marketing, helping in building strong relations with the consumers. Packaging is used as a tool for the communication of products’ brand values (Ford et al., 2012; Magnier and Schoormans, 2015). This is based on the package design, which can be defined as “the
various elements chosen and blended into a holistic design to achieve a particular sensory effect” (Pathak, 2014, p. 61). In fact, packaging may be representative of a product, as well as the company’s policies with regard to its eco-friendly packaging systems, its orientation towards sustainability and environmental protection. These elements, in combination with the packaging strategies, the visual aspects of packaging, help the company to differentiate itself from the competitors (Ford et al., 2012).

In fact, the materials used in and the design of package, such as colour, shape, images, combined with the packaging strategies used in the promotion of the products, have an effect upon the purchasing decision of consumers (Ford et al., 2012; Magnier and Schoormans, 2015). Some packages use mythical themes, in order to provide “narrative literary texts that go beyond labeling requirements”, conveying specific messages (Kniazeva and Belk, 2007, p. 52). Moreover, the design of the products, as their package, reflect their quality, which influence consumer behaviour (Hamelin et al., 2011). In addition, the package may have an impact on the product familiarity, an important element in product-consumer interaction, which again influences consumer behaviour (Huddleston et al., 2000). In addition, product design and labeling (e.g. the information provided about the nutritional contents, or the country of origin) influences purchasing decisions about certain products (Chen and Lobo, 2012).

This is true today more than ever, since consumers are more aware of the environmental problems and require from the companies to adopt packaging process, which is eco-friendly (Lamberti and Escher, 2007; Magnier and Schoormans, 2015; Jerzyk, 2016). These environmental concerns, along with the technology used in the production process (e.g. growth hormones, genetically modified elements, and agrochemical residue) and the packaging, affect consumers’ attitudes towards specific products (Deliza et al., 1999). Thus, if consumers think that the production process or the packaging of a product may be harmful, then it is highly likely that they will not buy it. Consumers are willing to buy products that are certified (Hsu et al., 2009), and
have been produced, transported, and packaged with environmental friendly ways and materials (Lopes et al., 2009).

As a marketing tool, package is very important in delivering the consumers a specific message, influencing positively (or negatively) their purchasing decisions, and giving consumers a reason to buy the product. Within this framework, Pathak (2014) describes the framework of evaluating the importance of packing as a marketing tool. This framework is called ‘IDEAL’, and is presented hereunder.

1. I for Intellectual: as Pathak (2014, p. 62) mentions, “Intellectual packaging is the need of the hour to generate likeability, strong affinity of the customer towards the product encouraging consumer affluence”. The package should be designed in such a way so as to make consumers notice it, and make it different from the products of competitors.

2. D for Distinct: the characteristics of the package (size, form, colour, text, material, and brand) make each package distinct from another. For some products, the package is so recognizable, so the consumers can differentiate (distinct) the brand in a meaningful way among other products.

3. E for Emotionally appeal: marketers try to add some features in the package (such as in its design, or logo, or information to consumers) that will influence consumers’ purchasing decision, evoking specific emotions, apart from just being attractive.

4. A for Aesthetic: the aesthetic design of a package is based on some features (e.g. colour, images, and shape) that have the ability to trigger emotional and psychological responses on behalf of consumers. Through these features, consumers are motivated to notice the product, and are provided information about its quality. At the same time, these features increase products’ competitiveness, and brand’s strength.

5. L for Logical: logical refers to the design of a product in such a way so as to be convenient and easy for the consumers to use it.

However, packaging is important not only in marketing in terms of increasing brand loyalty, market share, and adding competitive advantage. Packaging is also important
in delivering consumers convenience (Jiménez-Guerrero et al., 2015), and safety at the same time (Lamberti and Escher, 2007). Packaging is important in the supply chain process, since it enables the transportation, delivery, and bulk handling of the products. Furthermore, packaging protects the product from influences of the external environment and its exposure to factors that can cause contamination, allowing its proper preservation and its final delivery to end-consumers without any deterioration (Bellamy and Shuler, 2007; van Herpen et al., 2016). For this reason, it is supported that the interaction between the package and the physical environment (e.g. temperature, humidity, and pressure) may result in changes in the package performance and its life-cycle (Morris, 2017).

Moreover, it should be taken into account that packaging materials and their interaction with the product itself may have an impact upon consumers’ health (Eilamo et al., 1998; Lamberti and Escher, 2007; Jerzyk, 2016). The issue of safety of consumers’ health is crucial. Packaging materials should ensure that the product will be delivered to consumers without any deterioration, as well as the safety functions during the whole life cycle of packaging, namely storage, transportation, and disposal (Bellamy and Shuler, 2007). Taking food products as an example, it is supported by Nakazato et al. (2017) that bacteria and fungi can cause contamination of food, resulting in human infections. However, the ecological assessment of packaging is a complex issue (Ucherek, 2003). For this reason, it is proposed that the environmental impact and cost of packaging should be based on the life cycle assessment of all components (Jedlička, 2009). This highlights once more the importance of packaging package life cycle.

Thus, apart from marketing, packaging is important for the protection of the product, until it reaches consumers, namely from the point of production. For this reason, governments and the European Union have introduced regulations and standards with regard to environmental-friendly packaging (Sonneveld et al., 2005). This process, however, should be made through the optimization of the materials usage, the minimization of waste, and the recovery of the used packages (Envirowise Guide, 2014). This process is depicted in the following figure. As one can see, the concept of
packaging sustainability, which is going to be discussed later, starts with the optimization of the raw materials, as well as the energy sources used for packaging. The next step is the minimization of waste and the maximization of package performance, the logistic system used, and the efficiency of the whole system from production to consumption. The above have positive impact on consumers’ health, as well as on the environment benefiting again consumers. The last stage is the maximization of the recovery of the used packages. This is linked to the recycling behaviour of consumers, as it is mentioned in the next paragraph.

![Figure 5. The concept of sustainability for packaging and product systems (Source: Envirowise Guide, 2014, p. 5)](image)

Apart from the above, packaging may be an important tool in influencing consumer behaviour with regard to recycling, and consequently to the packaging life cycle assessment of a product supply chain (Wikström et al., 2016). Consumer perceptions about packaging can be influenced through the minimization of the impact of packaging material, such as the use of refill packaging, the smart and convenient product packaging, and the removal of excessive packaging. Thus, packing has an impact on wastes and recycling behaviour of consumers. This is based on the fact that package design may influence consumer preferences, and in general the interaction between consumer and the product. Several attributes of the package material and especially design influence the decision of consumers to be engaged in the recycling process: when a package is easy to be empty, to be clean, to be separated into
Last but not least, packaging is of importance since it is related to the logistics activity. More precisely, the cost of production, distribution and storage of a product, along with other functions of logistics are influenced by the packaging, leading to the emergence of a relatively new concept, named packaging logistics, which focuses on “the synergies achieved by integrating the systems of packaging and logistics with the potential of increased supply chain efficiency and effectiveness, through the improvement of both packaging and logistics related activities” (Saghir, 2004, p. 4). As it can be seen from the following table, there are many interactions between logistics and package, which can increase the cost of transportation and / or storage, or even the delay in delivery of the products.

Table 2. Relation between logistics and packaging

<table>
<thead>
<tr>
<th>Logistics activity</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transportation</strong></td>
<td></td>
</tr>
<tr>
<td>- <strong>Increased package information</strong></td>
<td>Decreases shipment delays; increased package information decreases tracking of lost shipments</td>
</tr>
<tr>
<td>- <strong>Increased package protection</strong></td>
<td>Decreases damage and theft in transit, but increases package weight and transport costs</td>
</tr>
<tr>
<td>- <strong>Increased standardisation</strong></td>
<td>Decreases handling costs, vehicle waiting time for loading and unloading; increased standardisation; increases modal choices for shipper and decreases need for specialised transport equipment</td>
</tr>
<tr>
<td><strong>Inventory</strong></td>
<td></td>
</tr>
</tbody>
</table>
- **Increased product protection**  
  | Decreased theft, damage, insurance; increases product availability (sales); increases product value and carrying costs |

**Warehousing**

- **Increased package information**  
  | Decreases order filling time, labour cost |

- **Increased product protection**  
  | Increases cube utilisation (stacking), but decreases cube utilisation by increasing the size of the product dimensions |

- **Increased standardisation**  
  | Decreases material handling equipment costs |

**Communication**

- **Increased package information**  
  | Decreases other communications about the product such as telephone calls to track down lost shipments |

Source: Saghir, 2004, p. 3

### 1.3 Sustainable packaging

All the above lead to the concept of sustainable packaging, which is one big challenge for the companies today. Sustainable development is defined as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Sustainable Packaging Alliance, 2002, p. 2).

The importance of sustainable packaging derives from the fact that sustainability in packaging should consider the three main pillars of the concept of sustainability, namely the economic, the social and the environmental (Sonneveld et al., 2005), which consists the ‘triple bottom line’ of packaging system (Sustainable Packaging Alliance, 2002). As it was mentioned, “society depends on the economy-and the economy depends on the global ecosystem, whose health represents the ultimate bottom line” (Fitzpatrick et al., 2012, p. 12). The following table presents the issues raised in each of these three sustainable pillars.
Table 3. Triple bottom line issues for companies

<table>
<thead>
<tr>
<th>Bottom line</th>
<th>Issues raised for the organizations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic</td>
<td>Cost competitiveness, Demand for products / services, Level of innovation, Human and intellectual capital, Profit margin</td>
</tr>
<tr>
<td>Social and ethical</td>
<td>Animal testing, Community relations, Human rights, Working conditions, Irresponsible marketing, impacts on indigenous people, Employment of minorities</td>
</tr>
<tr>
<td>Environmental</td>
<td>Environmental compliance, Use and protection of natural capital, Environmental management costs, Material/energy/water consumption, Solid waste and pollution, Life cycle impacts of products / services, Performance against best practice standards</td>
</tr>
</tbody>
</table>

Source: Fitzpatrick et al., 2012, p. 12

As it was mentioned, packaging is related to the logistics cost, the environment, and the social impact from a marketing and consumers’ safety perspective. In addition, it is supported that sustainable packaging should consider various levels of concern. For example, there is the micro-level, referring to the materials used (e.g. concerns about waste, toxic and safe materials). There is also the intermediate level of concern, related to the packaging system (e.g. efficiency during transportation, waste prevention, logistics / warehouse cost). Finally, there is the macro-level of concern, related to society (e.g. health and safety of consumers) (Sonneveld et al., 2005).

The reason for which sustainable packaging is so important, is because it has several benefits for the companies, the consumers and the society as a whole. More precisely, sustainable packaging leads to the efficient use of energy and materials, and thus towards cost reduction for the organizations. Moreover, an appropriate package design leads towards efficiency in the supply chain and in logistics, and hence towards reduced delay times in delivery and storage and transportation cost. Moreover, in
search ways for more eco-friendly packages, companies create closer relationships with suppliers, shareholders and consumers, leading to customer satisfaction and customer loyalty. Furthermore, sustainable packaging results in increased safety levels for consumers’ health, minimization of package waste, and the overall improvement of society’s well-being (Sustainable Packaging Alliance, 2002).

What should be mentioned, however, is the fact that in favour of marketing, packaging may not always follow the regulatory framework and the environmental principles, namely the sustainable packaging directives (Sonneveld et al., 2005). However, this perhaps could be overcome, based on the assumption of Magnier and Schoormans (2015, p. 60), according to which “the evaluation of affective attitudes towards an eco-designed alternative, and brand ethicality more generally, can be manipulated by changing the levels of analytical elements available to consumers”. One more reason that can cause a deviation from the sustainable packaging is the fact that companies may lack the kno-how or the sufficient funding for implementing methods that will allow them to use sustainable packages. One last reason for not adopting sustainable standards in packaging is the lack of understanding the term ‘sustainable’ (Sonneveld et al., 2005). The fact that there is a gap in what really constitutes sustainable packaging is also mentioned by Sustainable Packaging Alliance (2002).

The sustainable packaging can be measured through various Key Performance Indicators (KPIs). Overall, the sustainable packaging should have four distinct characteristics (Sustainable Packaging Alliance, 2010): a) effectiveness (fit for purpose); b) efficiency (minimal use of energy and materials); c) cyclicness (minimal waste); d) safety (it should not be toxic and should not pollute the environment). Based on these four characteristics, the Sustainable Packaging Alliance (2010) has issued some KPIs for the measurement of the sustainability of packaging. Some of these KPIs are presented in the figure below.
1.4 European Packaging and Packaging Waste Directive and CEN standards

The European Union has introduced a number of regulations and directives concerning the packaging and packaging waste. The primary directive is the European Parliament and Council Directive 94/62/EC of 20 December 1994 on packaging and packaging waste, according to which “Member States should take measures to prevent the formation of packaging waste, and to develop packaging reuse systems reducing their impact on the environment”. The following figure summarises the main requirements for packaging based on the European Packaging and Packaging Waste Directive.

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1 More information can be retrieved from here: http://ec.europa.eu/environment/waste/packaging/legis.htm
In addition, apart from the above mentioned KPIs, Europe has introduced some evaluation criteria for packaging on the basis of the Directive 94/62/EC, which are listed hereunder (CEN, 2016):

1) EN 13427:2004, Packaging – Requirements for the use of European Standards in the field of packaging and packaging waste;
2) EN 13428:2004, Packaging – Requirements specific to manufacturing and composition – Prevention by source reduction;
3) EN 13429:2004, Packaging – Reuse;
4) EN 13430:2004, Packaging – Requirements for packaging recoverable by material recycling;
5) EN 13431:2004, Packaging – Requirements for packaging recoverable in the form of energy recovery, including specification of minimum inferior calorific value;
6) EN 13432:2000, Packaging - Requirements for packaging recoverable through composting and biodegradation – Test scheme and evaluation criteria for the final acceptance of packaging.

Furthermore, CEN, the European Committee for Standardization, develops standards for packaging. For example, “CEN/TC 261 is responsible for the elaboration of standards dealing with terminology, dimensions, capacities, marking, test methods, performance requirements and environmental aspects in the field of packaging and unit loads. The field covers primary, secondary and transport packagings and unit loads, whatever the materials, shapes, contents or distribution system used” (CEN, 2016a). Under this committee, there are other two subcommittees (CEN, 2016a):

1. CEN/TC 261/SC 4: “This field covers all environment related aspects of packaging. SC4 will, among other things, deal with the following aspects: - material recovery, - energy recovery, - other types of recovery, - degradability, - symbology, - terminology, - determination of environmental impacts criteria”

2. CEN/TC 261/SC 5: “Sub-committee 5 studies general items whatever the materials, shapes or contents and whatever the distribution system and transportation chain adopted. SC5 establishes standards for primary packaging which is defined as all packages in direct contact with the product and for distribution packaging, transport packaging and unit loads including accessories”

1.5 Emergence of new packaging materials

The most common materials used in 2003 in packaging were paper, board, plastic, metal, glass, and wood. Paper and board accounts for the greatest market share in the packaging industry worldwide, followed by rigid and flexible plastics, metal and glass (World Packaging Organization, 2008). However, in 2014, flexible plastic is used more than the other package materials, as it can be seen from the following figure. This trend is expected to continue in 2019, as well, especially in Asia Pacific.
As mentioned above, packaging may cause human infections by bacteria and fungal pathogens (Nakazato et al., 2017). Moreover, due to the fact that the amount of packaging is constantly increasing, many organisations are pressured to take actions for addressing this issue, during the whole life-cycle of the product, since consumers have an increasing concern about the environmental impact of packages, especially the plastic ones (Klaiman et al., 2016). Within this context, companies may have as their aim to reduce the energy used during packaging, the minimization of the raw materials waste, the reduction of the carbon footprint, the increase of the renewable materials used in packages, as well as the recovery of the used packages (Envirowise Guide, 2014). For this reason, namely in favour of sustainability, companies try to introduce the concept of eco-efficiency in their packaging system, which means “increasing the efficiency of resource use and reducing environmental impacts to produce the same or greater economic value to business and the community” (Sustainable Packaging Alliance, 2002, p. 2). According to Fitzpatrick et al. (2012, p. 15), eco-efficiency is “a management philosophy that encourages business to search for environmental improvements that yield parallel economic benefits. It promotes activities that create more value with less impact”.

Figure 8. Package types worldwide by total volume, 2014 (Source: Euromonitor International, 2015)
Overall, innovation in packaging was driven by consumers’ needs and demands, lifestyle choices, as well as by the understanding of product life cycle (Lewis, 2012). As it is characteristically mentioned by Kalkowski (as cited in Jedlička, 2009, p. 34):

“Modern lifestyles, which demand longer product shelf life and create intense competition among brands, have been major drivers for increased usage of packaging, now seen as a leading contributor to waste streams. Pressure is mounting on the industry to act now.”

For the above mentioned reasons, new packaging material are discovered, so as to prevent contamination, especially in food products, such as silver metallic and polymeric nanoparticles, which have showed to have potent antimicrobial properties (Nakazato et al., 2017). Similarly, Deng et al. (2017) also claim that materials containing certain inorganic nanoparticles (e.g. chitosan and antimicrobial peptides) may be characterized by safe and effective in antibacterial performance, helping in the proper preservation and storage of products. The company ITENE tries to develop new packaging materials, so as to replace the packages currently used based on oil. For this reason, the company invests in the research in the field of biodegradable polymers. Its area of R&D includes not only the traditional packaging materials, such as polymers and paper, but also innovative materials, such as biodegradable/renewable. ITENE tries to develop nanocomposites, as well as “novel functionalities in materials through the use of additives, blends, coatings or specific processes” (ITENE, n.d.).

In addition, companies try to embrace new, environmental-friendly packaging materials, and packaging in order to promote recycling behaviour (Klaiman et al., 2016). For instance, in some countries, such as in France, in Germany and in the Netherlands, supermarkets try to promote a new concept regarding product buying. More precisely, some supermarkets offer products without packaging, where the consumers uses their bags and jars in order to fill or refill them with the products. Original Unverpackt (http://original-unverpackt.de/) is a prominent example of such supermarket. Even though packaging is important tool in marketing and the communication between the product and the consumers, as it has already been
mentioned, there are consumers who are not interested in packaging, since they find it wasteful and non-environmental friendly, and thus they tend to buy products who are unpackaged (van Herpen et al., 2016).

The new packages emerged should be in line with the sustainable packaging concept. Datschefski (2001, as cited in Sustainable Packaging Alliance, 2002) has proposed five basic principles for sustainable packaging, the so-called cyclic-solar-safe principles, as presented in the table below.

Table 4. Cyclic-solar-safe principles for sustainable packaging

<table>
<thead>
<tr>
<th>Principles</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclic</td>
<td>The product should either be made from organic materials and be recyclable or compostable or it should be made from minerals that are continuously cycled in a closed loop</td>
</tr>
<tr>
<td>Solar</td>
<td>The product should use solar energy or other forms of renewable energy that are cyclic and safe, both during use and manufacture</td>
</tr>
<tr>
<td>Safe</td>
<td>The product should be non-toxic in use and disposal, and its manufacture should not involve toxic releases or the disruption of ecosystems</td>
</tr>
<tr>
<td>Efficient</td>
<td>The product, in manufacture and in use, should require 90% less materials, energy and water compared to products providing equivalent utility manufactured in 1990</td>
</tr>
<tr>
<td>Social</td>
<td>The product’s manufacture and use should not impinge on basic human rights or natural justice</td>
</tr>
</tbody>
</table>

Source: Sustainable Packaging Alliance, 2002, p. 4
2. EXAMPLES OF INNOVATIVE AND SUSTAINABLE PACKAGES

Having discussed in the previous chapter the importance of packaging and the emergence of new packaging materials, this chapter aims at providing some examples of innovative and sustainable packages from various companies.

The project nano-Chitopack

Cinelli et al. (2013) refer to the use of fish-industry waste, in order to produce food packaging with low waste, which means low ecological footprint. The nano-Chitopack project tries to use chitin waste, a waste material from the fish industry, which is primarily used in the cosmetic industry, because of its bacteriostatic properties. However, chitin, which is characterized by high perishability, is regarded as a dangerous material for sea and land, and overall for the environment. As the authors state, “chitin, one of the two dominant natural polysaccharides, is a low-cost, natural biodegradable, biocompatible, compostable and non-toxic building block to develop low environmental impact food packaging materials. Chitin may improve barrier, antimicrobial and UV adsorption characteristics of the final chitin-based compounds”. Chitin is found in nature as fine fibrillar structures, which are called microfibrils or chitin nano-wiskers. These chitin nano-wiskers are considered to be better than conventional inorganic fillers, especially because they can be easily modified in chemical ways, because they are characterized by reactive groups (e.g. hydroxyl or amine) and high degree of biodegradability. “When the polymer matrix is a biodegradable, renewable material such as chitosan or a renewable bioplastic, i.e. poly(lactic) acid and polyhydroxyalkanoates, the new compounds will be 100% biodegradable and will be fully obtained from renewable resources” (Cinelli et al., 2013). For this reason, chitin nano-wiskers are considered to be used as nanofiller for nanocomposites. The aim is to use them in the production of packaging and functional bacteriostatic films in the food industry, since they have increased resistance to UV and heat, and they are 100% bio-degradable. The aim is to optimize existing biodegradable materials by adding chitin nano-wiskers to biodegradable thermoplastics that are used nowadays (Cinelli et al., 2013).
Innovation in the company Dell is not limited only in its technology, but it expands to its packaging materials. Dell has a program, known as 2020 packaging goals, which aims at establishing a waste-free packaging stream. This will be achieved through the following (Dell, 2016b): a) the company will use 100% sustainable packaging materials, such as recycled, and organic waste; b) the company’s packaging will be 100% recyclable or compostable. This plan is based on the achievements of the company so far. In 2012 the company reduced the size of packages for desktops and notebooks more than 12%, increased the use of recycled and renewable content in its packages about 40%, used packaging recyclable at curbside up to 75%, and removed about 20 million pounds of packaging material (Dell, 2016b).

In an effort to find zero-waste packaging materials for its heavy products, the company decided to invest in agricultural waste, so as to create greenhouse gas emissions packages. For this reason, Dell grows cushions made from mushrooms, and the final product is an organic, sustainable and compostable material, which looks like Styrofoam (Dell, 2016). Mushroom cushions are custom-engineered “and are grown through a low-energy and automated process, which involves filling the raw materials evenly into forms that allow them to take the final shapes. The mycelium is mixed with regionally sourced agricultural waste and grows indoors without the need for light, watering, or petrochemicals” (Spinner, 2012). The procedure is as follows: at first, cotton hulls, rice hulls or wheat chaff are placed in a mold and injected with mushroom spawn. After 5-10 days, mushrooms have grown using only the energy that exists in the agricultural waste, without the use of petroleum. This innovative idea of Dell is consistent with its C’s philosophy (Dell, 2016):

1. Cube: aims at reducing boxes’ size
2. Content: aims at making the packaging materials friendly to the environment
3. Crub: aims at making the materials used in packages curbside recyclable

Before using this material replacing the current polyethylene cushioning, the company announced that more tests need to be done, although the pilot growing of mushroom
cushioning in server shipments in FY13 provided some initials positive results. As the company stated in its official website (Dell, 2016):

“The mushrooms are grown in engineered molds to create the cushions, so the process is by nature less automated than that of creating plastic cushioning. This presented some hurdles in terms of continuity in supply and material cost, but developments in manufacturing combined with recent testing have put us on track for a FY16 re-introduction of mushroom-based server cushioning”.

Apart from mushroom cushions, the company Dell invests in research regarding the use of bamboo so as to package its lightweight products, which is certified by the Forest Stewardship Council, and has been characterized as biodegradable and compostable, with advantages to plant growth, due to its good quality. Bamboo as a packaging material is considered as an alternative to the current foams, corrugate and molded paper pulp materials (Dell, 2016a). What should be mentioned is that the whole process is characterized by sustainability. At first, bamboo grows near the company’s facilities, which results in reduced carbon footprint related to the packaging process. Second, after its harvest, bamboo is mechanically pulped, without any toxic chemicals, where 70% of the water is reclaimed and used in the process. Third, the bamboo pulp dries in the sun, without using any electricity. In addition, bamboo does not require replanting, in the case of correct harvest, whereas the plant helps in the protection of soil erosion (Dell, 2016a).

In addition, after mushrooms and bamboo, the company has invested in wheat waste as a packaging material. Wheat straw is the canes that have left after the harvest of the wheat grains. Dell uses wheat waste as it upcycles it in the boxes using for shipping products. Instead of pulping wheat waste in chemical manners, the company uses a process similar to cow’s digestive system in order to break down the waste with enzymes. With this process, Dell uses 90% less water and 40% less energy. After this process, the material formed is mixed with other fibers, mainly from recycled paper, so as to produce boxes. Currently, about 15% of the company’s boxes derive from wheat straw (which is translated to 200 tons of wheat straw on an annual base), with
the aim to further increase this percentage. For the time being, the company has reduced its CO₂ emissions by 180 tons approximately. The final product is not different from a regular cardboard, except from the fact that is recyclable.

Apart from the above, the company has cooperated with Newlight Technologies’ AirCarbon®, in order to produce protective bags for notebooks shipped to the U.S.A and Canada that include captured carbon emissions, in an effort to reduce the amount of oil, of other fossil fuel derivatives, and of the energy used in the production of plastics. As the company states in its official website, “AirCarbon is a thermoplastic material made by combining industrial sources of methane-based carbon emissions, such as methane from dairy farms, digesters and landfills, with air to produce a thermoplastic polymer” (Dell, 2016c). On the contrary, Newlight uses “a biocatalyst to carry out a carbon sequestration process in a water-based reactor, where carbon emissions are combined with air and converted into long-chain thermoplastic polymers by a biocatalyst at a yield that is 9 times higher than previous technologies” (Dell, 2016c). The new material can either be used alone, or incorporated into other materials, as for examples Dell’s linear low density polyethylene (LLDPE) bags. With this process, the cost reduction is an achievable goal, while at the same time the products capture carbon (methane emissions), which would otherwise spread in the air. Due to the fact that AirCarbon insulates more carbon dioxide equivalent greenhouse gas than is emitted to produce it, it has been characterized as a carbon sequestration material (Dell, 2016c).

**Mushroom packaging**

Not only Dell has invested in mushroom packaging material. The company Ecovative is an innovative company, trying to produce eco-friendly materials for furniture components and surfaces, play toys, and packaging as well. At this section we will focus on the materials produced for sustainable packaging. Mushroom packaging is an effort to replace EPE- polyethylene foams. Its advantages, as mentioned earlier, are that it is compostable, without abrasive substances, and without being based on petroleum or food (Ecovative, 2016). Apart from Dell, other companies that manufacturers make use of this innovative, sustainable product. Rich Brilliant Willing
(RBW), manufacturer in the field of LED lighting, uses Mashroom packaging in the so-called Restore packaging, as a supplement to its energy-efficient solutions in lighting (Ecovative, 2016). The company Stanhope Seta operates in the field of laboratory instruments for quality control, analysis and calibration. The company set three goals regarding its packaging: protection of the products as they are delivered to customers, easy pack up products, and sustainability in its packaging materials (Ecovative, 2016). Merck Forest and Farmland Center has a Vermont-certified organic sugarbush for producing syrup. In an effort to make the whole process more sustainable and eco-friendly, the company uses mushroom packaging so as to ship its products. The same packaging material is also used by the company SPOR, in order to ship safe its solar powered products and accessories (Ecovative, 2016).

**Tetra Pak**

In 2014 Tetra Pak introduced its first carton, made exclusively from plant-based, renewable packaging materials. The new carton, the Tetra Rex® carton, is the first having “bio-based low-density polyethylene (LDPE) films and bio-based high-density polyethylene (HDPE) caps, both derived from sugar cane, in addition to Forest Stewardship Council (FSC™)-certified paperboard” (Hower, 2014). The company already used approximately 70% of renewable resources in its cartons, whereas this percentage was increase by 4% with the use of bio-based caps (Hower, 2014).

**Ainia**

The company Ainia tries to produce eco-friendly packaging materials, which will result in the decrease of the dependency on fossil raw materials, through the innovations in organic waste. Within the context, biopolymers were produced, through anaerobic fermentation (bioproduction) of food waste. In addition, the company develops biodegradable packaging, using materials that will not burden the landfill in their process of degradation (Ainia, 2016). An example of this effort is the production of Succipack, which is a new bioplastic from 100% renewable sources. Another example is the European project pHBottle, which was produced through the fermentation processes using food waste (Ainia, 2016).
**European project pHBottle**

The aim of this project “is to develop a biodegradable material (PHB, polyhydroxybutyrate) by fermentation of food industry by-products (juice processing wastewater)” (pHBottle project). The figure below illustrates its life cycle assessment.

![Figure 9. Life cycle assessment of pHBottle (Source: http://www.phbottle.eu)](image)

The goal of the whole project is to use juice industry by-products as bioproduction alternative, and functional materials (cellulose microfibers and encapsulated ingredients), with the aim to reduce the energy used and produce an eco-friendly packaging material. pHBottle has similar properties to plastic polypropylene, which is petrol-based, and more precisely: moisture resistance, lower water vapour permeability, water insolubility, optical purity and good oxygen barrier. The wastewater from the juice industry is characterized by increased amounts of organic pollution, such as fermentable sugars (e.g. fructose), and free carbohydrates. For this
reason, this wastewater will be used in the pHBottle bioproduction, placing also emphasis on the safety and quality of the packaging material (pHBottle project).

**Sustainable package design**

Even though the issue of package design it is beyond the scope of this dissertation, it is interesting to present in brief some package design examples from companies, under the moto ‘reduce, reuse and recycle’ (Bowler, 2016).

Under the Fuse Project, the company Puma has changed its concept of traditional bags, introducing a new concept. These bags use fewer raw materials, contributing to saving energy, such as 60% of water, while they can also be re-used (Bowler, 2016)

These eggs are delivered to consumers in recyclable paper, wrapped with newspaper, providing all the information consumers need (Bowler, 2016)

The minimization of package, especially in shipping, was behind the idea of the bags used by Hanes, in order to send a T-shirt. Apart from this, these boxes as made entirely from recycled materials (Bowler, 2016)
The package of Veuve Clicquot is biodegradable from both potato starch and recycled paper, with isothermal properties that help the bottle remain cool for two hours after being removed from the refrigerator (The Dieline, 2013). Method uses recycled plastic and plastic collected from the oceans to produce its packages. This helps not only in brand awareness, but also in consumers’ education (The Dieline, 2013).

Sustainable package designs are efficient in shipping, with less footprint emissions. For this reason, it is of great importance for the companies to adopt a life cycle approach, which will provide them information about the advantages and the impact of the packaging system they use. In addition, through this approach companies can control their packaging system, implementing changes and improvements if it is necessary, so as to further enhance the sustainability of their packaging process. Sustainable package design should ensure product protection, brand awareness, easiness of product handling, and product shelf life (Packaging Design for Sustainability, n.d.). Apart from this, sustainable package design should place emphasis on the minimization of resource utilization, water and energy consumption, acidification, solid waste, and greenhouse gas emissions (Packaging Design for Sustainability, n.d.).

Three design strategies have been proposed within the context of sustainable package design (Packaging Design for Sustainability, n.d.).

1. Design with responsibly sourced materials: there should be a careful selection and usage of materials, based on the fact that each material has specific features, and thus advantages and disadvantages when used within the context of sustainability.
2. Design for efficient material usage: this means to minimize the materials used in the package system, but still finding an innovative solution that will contribute to consumers’ health protection, safety, efficient delivery of products to end consumers, environmental protection, and brand awareness.

3. Design for recovery: the re-use of a product leads to new life cycles, minimizing its negative impact to the environment.
3. DISCUSSION

The aim of this chapter is to make an overall discussion regarding the importance and the functions of packaging, the factors that should be taken into account in packaging design and process, the benefits of sustainable packaging, as well as the implications of the basic outcomes of the present study.

3.1 Discussion

The above analysis placed emphasis on the functions of packaging, and the need, as well the emergence, of new, eco-friendly, sustainable packaging materials. However, it should be remembered that a package should fulfil a number of specific functions, in accordance to the basic functions mentioned by van Herpen et al. (2016) and Pathak (2014) above, as they are listed hereunder (Envirowise Guide, 2014):

1. The packages should be attractive, so as to positively influence consumers to buy the product
2. The package should be easy to be carried by the companies, and primarily by the consumers
3. The package should be easy to be opened by the consumers (but not through an accident), and pilfer-resistant
4. The package should allow the liquids to be poured into, without spillage and leakage
5. The package should be delivered to the consumers in good condition
6. The package should protect the product from contamination and deterioration from environmental factors, and the distribution, throughout the whole supply chain process (production, storage, distribution, consumer)

The first function is related to the fact that package is one of the most important and the first means of communication between a product and a consumer, whereas it can be a differentiating factor for a company from its competitors (Ford et al., 2012; Delgado et al., 2013; Jerzyk, 2016). The package may influence consumers’ purchasing decisions through its colour, shape, design, logo (Ford et al., 2012), while at the same
time it can reveal information about its quality (Hamelin et al., 2011), and provide useful information about nutritional contents (Chen and Lobo, 2012). Furthermore, packaging may influence consumers’ behaviours towards recycling and re-use of the product (Jiménez-Guerrero et al., 2015; Jerzyk, 2016).

The functions 2-5 are related to the primary characteristics that a package should have. Consumers should find it easy to carry and open the package, aiming at consumers’ convenience and better service. This will lead to the re-purchase of the product. In addition, the package should be delivered in good condition, in order to reflect the quality of the product itself, and thus being more attractive for the consumers, further influencing positively their purchasing decisions, since it will have no flaws.

The last functions is related to the importance of packaging for the protection of the product, the avoidance of contamination and deterioration from external factors, such as environmental factors (e.g. humidity, pressure) (Nakazato et al., 2017), the interaction between the product and the package (Eilamo et al., 1998), and the distribution and storage of the product (van Herpen et al., 2016).

Thus, the factors that should be taken into account in packaging design and process are the following (Envirowise Guide, 2014): technical performance, fit for purpose, environmental requirements based on European and national legislation, consumers needs and demands, differentiated from competitors, attracting consumers (appealing package), consumers’ health and safety, supply chain and logistics, cost of packaging. Overall, as it is depicted in the following figure, there are three main stages that should be considered in the process of packaging towards sustainability:

a) Production: the production of the package should be cost-effective, and compatible with the national and European regulations and environmental standards, with specific technical performance and characteristics, ensuring the safe delivery, as well as consumers’ needs and requirements, and taking into consideration the interaction of the product with the package and the environment.
b) Distribution: over-complexity should be avoided, which means that the package should be simply designed, taking into account any marketing aspects along with consumers’ needs and requirements. In addition, the package should be easy to be handled, while it should ensure its appropriate storage, preventing any contamination and deterioration, minimizing warehouse, allowing the increase of transport loads, optimizing product flows, and minimizing product wastage.

c) Consumption: the package should ensure that the product has been delivered to consumers without any damage or waste, taking into account the use (re-use) of the package at the end of its life-cycle.

Figure 10. Packaging process toward sustainability (Source: Envirowise Guide, 2014, p. 16)

The importance of packaging sustainability can be observed from the table below, where the benefits of sustainability in packaging are listed.
Last but not least, since this study mentioned briefly sustainable package design as well, the following table presents some tips, along with some examples of various companies.

Table 6. Sustainable package design: tips and examples

<table>
<thead>
<tr>
<th>Tip</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adopt a life-cycle approach</td>
<td>The Sustainable Packaging Coalition’s COMPASS® (Comparative Packaging Assessment) online design software can help companies to make better decisions in material selection and assess their environmental impact</td>
</tr>
<tr>
<td>Evaluation of each component of the package</td>
<td>LIV Organic’s sports drink has changed from using PET bottles to bottles with Amcor’s Groovy finish technology, enabling the company to reduce the weight of the bottle, and to use 31% less resin than a standard 38-mm finish</td>
</tr>
<tr>
<td>Finding alternatives to product distribution</td>
<td>The bottle Nested Pack™ from Polypack is more attractive to consumers, uses less materials, and is easier to be disposed after its use. Moreover, the food maker Premier Organics uses a reusable polypropylene pallet cover that can be re-used up to 250 times</td>
</tr>
<tr>
<td>Design re-usable packages</td>
<td>Pizza Hut in Costa Rica has introduced a box that can be turned into plates</td>
</tr>
<tr>
<td>Change of the product</td>
<td>Several companies especially in the housecleaning industry have changed their products, such as General Mills’ Betty Crocker Hamburger Helper</td>
</tr>
<tr>
<td>Package design for recyclability</td>
<td>EarthCoating from Smart Planet Technologies can be used as an alternative to 100% polyethylene coatings in high-barrier folding carton applications</td>
</tr>
<tr>
<td>Package design attractive to consumers</td>
<td>Companies should introduce package designs that will increase the possibility of being used by consumers, as for example Hellmann’s Easy Out! Mayonnaise package</td>
</tr>
<tr>
<td>Knowledge of the source of packaging materials</td>
<td>Companies should make sure that they use responsibly sourced packaging materials, as for example the use of non-Genetically Modified (GM) crops from Stonyfield Farm</td>
</tr>
<tr>
<td>Evaluation of the product distribution</td>
<td>Companies should assess their distribution process, so as to make sure</td>
</tr>
</tbody>
</table>
they use less space, in order to reduce logistics cost

**Usage of renewable materials**  
Companies should invest in using materials based on renewable feedstocks

Source: Mohan, 2012

### 3.2 Practical implications

An addition to packaging materials, packaging design should also be a concern of the companies, in an effort to be environmental friendly, without losing the advantages of packaging in terms of marketing and customer attraction. Some examples were stated above, in an attempt to indicate the importance of this issue as well. Due to the fact that this study focused on packaging materials, no further analysis of packaging design was included. Perhaps this could be an issue of further study.

However, what should be mentioned is the statement of Ben Sillence, Strategy and Innovation Manger of Path (The Dieline, 2013):

> “The future of sustainable packaging will not just be in material usage, lightweighting and recycling - it will be about empowering consumers with the ability to lead their lives in a more environmentally positive way. In what ways can your branded packaging enable people to use your product more responsibly and efficiently?”

The above statement makes it clear that the efforts of companies alone in using eco-friendly and sustainable packaging materials is not enough in the field of sustainable packaging. Consumers are important factor in this process. This has been acknowledged by the companies, which try not only to use sustainable packages, but also to make this packages look more appealing, and at the same time present the packaging materials as delivering added brand value.
The companies should exploit the fact that consumers are willing to pay more for environmental friendly products. This was the outcome of a research conducted by Nielsen Company in 2014. More precisely, it was found that about 52% of global consumers from 60 countries are influenced in the purchasing decisions from the package. Half of the respondents check the package for sustainable labeling, whereas half are willing to pay extra money for sustainable products (Nielsen, 2014). Nevertheless, the impact of economic crisis and the debt crisis in some countries, such as Greece, along with the high unemployment rates, perhaps have an adverse effect on sustainable products with higher prices than the traditional. For instance, a survey from McKinsey company indicated that consumers are willing to pay more for sustainable products, but only up to a certain point (Miremadi et al., 2012). Overall, it is supported that the price may outweigh the attribute of recyclability, compostability or energy efficiency (Szaky, 2013). Perhaps consumers’ education and the provision of information to them regarding sustainable packaging would be useful and could bring the desirable results. Thus, apart from the efforts of companies, the education of consumers is needed.

Consumers should be more informed and educated not only in the use of recyclable products, but also in the use of innovative packaging materials, such as those from food waste. They should be informed about the need of incorporating these materials in the businesses’ packaging practices, as well as the advantages of the materials used. This information could be provided by the companies themselves, as well as by the mass media. In addition, the companies could invest in campaigns, related to the use of innovative and sustainable packaging materials, in order to inform the public, and to raise their brand awareness.

This proposition is in line with a relatively recent survey conducted in U.S. consumers, according to which consumers would be willing to pay more for sustainable packaged products, if they knew how this would help in environmental protection. More precisely, this survey found that U.S. consumers are not aware of resource scarcity, but if they had information about how renewable materials mitigate climate change, then their purchasing decisions would be influenced (McNally, 2015). As Elizabeth
Comere, Director of Environment & Government Affairs for Tetra Pak US and Canada, characteristically stated: “Our survey confirms our belief that with information and education, consumers will respond favorably to the need to pay closer attention to resource challenges and change their individual actions, including making more environmentally responsible decisions around packaging”.
4. CONCLUSIONS

4.1 General conclusions

The present study tried to contribute to the existing literature regarding packaging in various ways. At first, this is a study tried to put together all the functions of packaging, analyzing the importance of each function, and the significance of packaging as a whole. Second, this study placed emphasis on the need of sustainable, eco-friendly packages, since packaging is an issue related to issues of both public health and environmental protection. Third, the present study tried to resent some new materials used by the companies in their packaging. Through these examples it became obvious that package plays a crucial role in marketing strategy and brand awareness, as well as in consumers’ safety and health and environment protection. Due to the harmful impact of some materials, such as oil-based plastic, to the environment, and the environmental concerns on behalf of the consumers, new sustainable, innovative eco-friendly packaging materials have emerged, used already by some companies, as it was indicated from the examples above.

Overall, based on the above analysis, packaging serves three main functions. The first is the logistical function, according to which the package protects the product and the environment, facilitates its distribution, and provides information to consumers. The second is the marketing function, according to which packages should be of certain design, colour, share, dimension etc, so as to meet costumers’ needs and requirements for convenience, carriage, health and safety, and to meet specific regulatory standards and demands. The third is the environmental function, according to which packages should take into account their reusability, minimization of waste etc. In general, companies try to meet the sustainability issues concerning package, due to the impact of packaging upon environment, logistics cost, and society, and because they understand the importance of adopting a holistic approach to packaging, meeting the requirements of all stakeholders, such as shareholders and consumers.
What is important to be mentioned is that, from the above it stems that: a) consumers may be influenced by the package to adopt more environmental-friendly consumption habits; b) consumers are influenced by the package to buy a product and build loyal relations with the brand; c) consumers are and informed by the package about the product and the content; d) consumers need packages that serve their needs in relation to the specific product packaged (fit for purpose), especially convenience, as well as safety; e) companies should adopt packaging techniques and methods that prevent hazardous effects on products, avoiding any contamination and distortion through the whole supply chain, from the production until the product reaches the end-users, namely the consumers.

Based on the above, packaging can be used so as to change consumers’ behaviour towards green thinking, when it comes to their purchase decisions concerning products. Besides, the interaction between companies and consumers is two-way. On the one hand, consumers’ demands for green practices on behalf of the companies, and their need for products who place emphasis upon their safety, force companies to implement practices in their packaging, in an effort to meet these demands. On the other hand, companies can shift consumers’ behavior towards more environmental friendly and sustainable purchase patterns.

4.2 Suggestions for further research

This study tried to examine the issue of packaging, sustainable packaging and packaging materials through the secondary research method. However, it would be of great importance to conduct a primary research to companies from various sectors of the economy, in order to examine their perceptions about the aforementioned issues. In addition, a primary research to companies would allow to identify whether companies try to implement the basic principles of sustainable packaging, as well as the factors that influence them towards the adoption of specific package characteristics (e.g. shape, colour, design, materials). Such a study could lead towards useful results concerning the practices used by the companies, the identification of
factors that drive their decisions regarding packaging, as well as the determination of factors that may hinder the implementation of sustainable practices in packaging.

Of great interest and importance are consumers’ perceptions regarding sustainable packaging. Since packaging influences consumers’ purchasing decision, as well as their behaviour towards recycling and environment, their opinions regarding the issue of sustainability in packaging are important. Hence, a future primary study could be conducted to consumers. As it is mentioned by Nordin and Selke (2010), there is not so much research concerning consumers’ perceptions about packaging sustainability. Moreover, there is a need for more researchers about how consumers evaluate and process eco-friendly designed market alternatives. Since consumers increase their concerns with regard to environmental friendly products, and health and safety issues, it would be of great interest to examine the perceptions of consumers with regard to whether they believe companies’ packaging as eco-friendly and safe, to the package factors that influence their purchasing decisions, and their recycling behaviour. Such a research could offer an insight into the social dimension of sustainable packaging, leading to outcomes that would be useful in making suggestions for improvement in the sustainable practices of companies related to packaging.

Last but not least, this study briefly mentioned the importance of sustainable package design, stating some examples. However, this issue is beyond the scope of this dissertation. For this reason, a further study could examine practices related both to environmental friendly package materials and design. Perhaps in such a study, the opinions of managers and other executives of companies would be useful, in examining the importance they place on sustainable packaging and design, the efforts that they have made so far in this field and how they are considering to proceed, as well as potential obstacles in this effort. The study of both packaging materials and design would be more complete and provide interesting results regarding the steps undertaken by the companies in this area of R&D.
REFERENCES


