TITLE: Mapping requirements in a sustainable packaging decision for actors of the supply chain

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Abstract

Decision-making is a crucial part to sustainable packaging area which needs stakeholders to select the best solution amongst alternatives. Different needs and constraints embedded from different actors of supply chain create a trade-off in packaging decision. This research, therefore, is seeking to understand the nature of that trade-off, and mapping all requirements from actors of supply chain on the sustainable packaging decision based on a holistic view in order to select an optimal trade-off which can reduce the total cost, mitigate total impact on the environment and social dimension, and identify the opportunities for a win-win solution of a whole supply chain further.

Keywords: Sustainable packaging, Decision making, Supply chain

Packaging

Initial definition of packaging

Packaging is defined as the science, art and technology of enclosing or protecting products. Packaging has a number of physical attributes such as design, colour, shape, labelling, symbol and material used (Ampuero and Vila, 2006; Khan et al., 2015; Underwood, 2003). Packaging is also recognised as a part of a modern marketing operation which covers all stages of activities related to the transfer of goods and services from manufacturer to consumer (Agariya et al., 2012).

Packaging at the current time has become increasingly significant in creating consumer's satisfaction especially in terms of the marketing communication and environmental considerations (Swami and Shah, 2011). In fact, packaging has been known as a "silent salesman" since most consumers make their buying decision at the point of sale, and packaging is the first thing consumers see and is what forms the basis of their decision to purchase (Agariya et al., 2012; Ahmad et al., 2012; Ampuero and Vila, 2006; Silayoi and Speece, 2004; Wells et al., 2007). The design of packaging, therefore, need to be considered carefully (Swami and Shah, 2011).

Types of packaging

Packaging can be classified as primary, secondary or tertiary, a terminology based on the hierarchical level of the package (Ampuero and Vila, 2006; Hellstrom and Saghir, 2007; Sohrabpour et al., 2012).

According to Ampuero and Vila, (2006), primary packaging is in direct contact with the product, for example, the perfume bottle. Secondary packaging contains one or more primary packages aiming to protect the product, communicate its details, and identify the number of products e.g. cardboard box, wrapping tray and tertiary packaging such as big cardboard box and pallet is to protect the bulk product in a handling, shipping, and distribution process (Loucanova et. al 2016; Rundh, 2016).

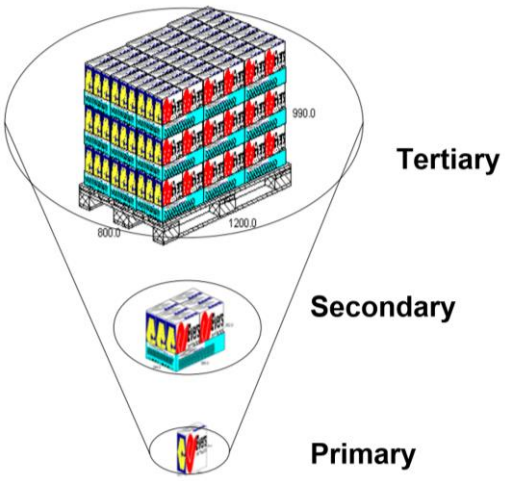

Figure 1 Types of packaging (Source: Hellstrom and Saghir, 2007)

Roles and functionality of packaging

The traditional function of packaging is to contain and protect goods during transit through distribution channels (García-Arca et al., 2014; Rundh, 2016; Silayoi and Speece, 2004).

Packaging also has a convenience role which includes product identification and logistic supporting functions (Ampuero and Villa, 2007; Bech-Larsen, 1996; Silayoi and Speece, 2004; Thiendej and Chaipoopirutana, 2016; Underwood, 2003). This role is to support the handling, storage, and transport activities by informing users of the convenient way of using the product in every stage of the supply chain (García-Arca et al., 2014; Hellstrom and Saghir, 2007). Another roles of packaging is the marketing support because packaging can promote sales of products, differentiate the products from competitors, create a brand image, enhancing brand loyalty and communicate the product's information to targeted customers (Ahmad et al., 2012; Thiendej and Chaipoopirutana, 2016)

Sustainable packaging

Definition of "sustainable"

Generally, 'sustainable', 'green', and 'eco-friendly', are interchangeable words to express how the people who use this word are concerned about environmental issues and how they are aware of the use of natural resources in negative ways (Miller, 2007; Mutingi, 2013). In this study, sustainable is defined as a process into a more environmentally friendly direction by considering the emission of greenhouse gas over the lifetime of a product (life cycle assessment; LCA) which cover the selection of raw materials, manufacturing, transportation, consumption, and how to cope with expired products in order to minimise the total amount of carbon dioxide released into the atmosphere at a reasonable cost (Srivastava, 2007).

Adding the term "sustainable" into packaging

Sustainable packaging originated from the concept of sustainability defined in 1987, in which packaging could contribute to sustainability because it could increase product protection, decrease product deterioration, and make economic development more sustainable (Martinho et al., 2015). Sustainable packaging refers to a process of designing and producing which requires a recycling of energy and resources in order to protect the environment and preserve the energy throughout the lifecycle (Jiang et al., 2015).

Sustainability has been placed on the political agenda. This has led to the introduction of much legislation e.g. EU directive 94/62, packaging waste regulation and packaging essential requirement (1997 and 1998 respectively) of the United Kingdom, and the environmental agency law of 2013 (White et al., 2015).

Sustainable packaging decision making

Actors of the current sustainable packaging decision making

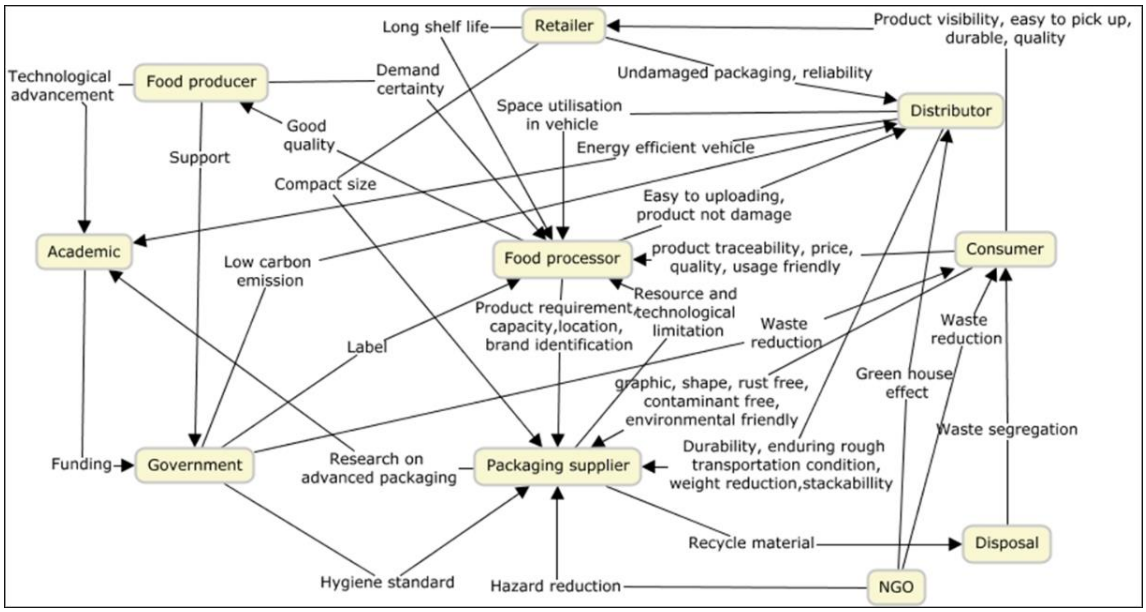

Figure 2 Mapping between packaging actors and their requirements

A literature review was used to identify actors' requirements and their relationships in the packaging supply chain as shown in Figure 2. This figure is generated based on the study of main actor for the packaging supply chain together with the requirement of each actor toward others. This mapping is beneficial to the reader to understand the nature of relationships and requirements amongst packaging supply chain because these can affect the packaging decision-making process (Vermeulen et al., 2013). . The direction from arrow tail to arrowhead means the arrow tail actor requires support or action from arrowhead actor. For instance, academic requires support from government. Details of each actors and its requirements are described as follow:

The main actors consist of packaging supplier, filling or manufacturing company, logistics service provider, retailer, consumer, government, and NGOs (Vermeulen et al., 2013; Niemelä-Nyrhinen and Uusitalo, 2013; Dani, 2015). There are, also, supporting actors including academia, products supplier, and disposal agent (Vermeulen et al., 2013, Dangelico and Pujari, 2010).

For the packaging supplier, the requirements are related to manufacturer which are the convenience attribute e.g. the sufficiency of packaging materials, simplicity of packages and standardisation of package size, cost, and capacity (Niemelä-Nyrhinen and Uusitalo, 2013).

- Also, this relationship requires support from research on advanced packaging material conducted by academics and researchers (Dani, 2015).

- Furthermore, packaging suppliers must be most concerned with policy, rather than quality or performance (Sohrabpour et al., 2012). This is because media and regulation affect to brand packaging policy to a higher degree than NGOs such as Greenpeace, which promotes the reduction of hazard in the world, does (White et al., 2015). In addition, it is mentioned that the company needs to set up their strategy to conform to regulation and rules of the buying country (Biles, 1992; Grubow, 2007).
- In legal consideration, packaging must have the functionality of protection to protect handlers and the public environment from possible harm (Biles, 1992). Moreover, in Thailand, food packaging is regulated by the Food Act B.E. 2522 (1979) which bans 'Food in containers made from materials that may be health hazard' (Food and Drug Administration, 1979). The Ministry of Public Health is responsible for enforcing food law as a whole, and has the power to issue Ministerial Regulations for the implementation of the provisions of the Act. The Food and Drug Administration of Thailand (FDA), an agency in the MPH, is responsible for dealing with the food packaging including packaging material review and approval. The Ministry's Declaration No. 92 of 1985 requires that food containers must be clean, free of germs, free from heavy metals or other substances contaminated with food that may be hazardous to health, and also forbids reusing certain types of food containers, for instance (Food and Drug Administration, 1985).

For the material supplier, a firm must evaluate potential suppliers when choosing a supplier on the basis of availability of technology, availability of skilled labour forces, a requisite standard of quality, and technical support, volume flexibility, and product flexibility (Rundh, 2016).

For the producer or filler, it is necessary to consider production costs, manufacturing factors, and product requirements (Rundh, 2016). In addition, Sohrabpouret al. (2012) state that, in terms of production, packaging designer needs to focus on how easy to handpick the products which results in large package preference, especially for the secondary packaging. This could affect the quality management because it is hard to ensure the correct number of products, and it increases the likelihood and severity of risk.

- Also, the manufacturer requests the convenience attribute in terms of material specificities such as thickness, shape, size, and the communicative attribute through the ease of checking content (Niemelä-Nyrhinen and Uusitalo, 2013). For the production costs, it deals with labour cost, material cost, product quality, and availability of products (White et al., 2015).
- It is also concerned with product specification such as fragility, type of material, product limitation, and technology to be made. Each material has its pros and cons. Glass, for example, is impermeable to moisture and gas, but it is brittle and breaks easily. Plastic, on the other hand, can support products in any shape (Marsh and Bugusu, 2007; Rundh, 2016).
- Another thing which deserves consideration is environmental protection through the reduction of packaging size and weight, the use of recycling material, and the

assessment of energy consumption. For the regulation aspect, food packaging in Thailand may need to comply with the new standards proposed by the Thai Industrial Standards Institute (TISI) both compulsory and voluntary standards. Currently, only mandatory TIS which affects food packaging industry is TIS. 51-2530 (1987) for canned pineapple (Thai Food Act, 1987).

The distributor requires the protection attribute and the convenience attribute in the shopping process. The former attribute involves strong packaging which ensures the products could endure rough manual handling and transport conditions. This is because there are a large number of suppliers along the supply chain who have different transportation modes. The convenience attribute involves improving stack ability with proper size, density, and weight, which also require some technology such as barcode in providing a communication attribute (Niemelä-Nyrhinen and Uusitalo, 2013; Rundh, 2016; Sohrabpour et al., 2012; Vernuccio et al., 2010).

- Furthermore, logistical components, such as infrastructure, handling equipment and logistic system, have an important impact on the productivity of logistic channels, and affect the endeavour of pallet standardisation, although the cost of packaging disposal is often omitted because the packaging decision mostly deals with the engineering department rather that the logistic (Hellström and Nilsson, 2011; Twede, 1992).
- In addition, the cost of logistics which affects the material selection, packaging size, and the number of packs per grouping, needs to be considered (Twede, 1992). Also, the promotion of renewable energy vehicles by NGOs and government affect the logistic decision in the food supply chain (Dani, 2015).
- However, Niemelä-Nyrhinen and Uusitalo (2013) suggest that from all of distributor's requirements regarding the packaging decision, the durability to cope with many situations seem to be the most significant factor.

The retailer requires a high stacking capability for better storage optimisation (Sohrabpour et al., 2012). This leads to the requirement on packaging supplier.

- In addition, the retailer is concerned about the ease of uploading and unloading, ergonomics, and the ease of sorting with a clear marking. (Niemelä-Nyrhinen and Uusitalo, 2013; Sohrabpour et al., 2012). This leads to the requirement on distributor.
- Furthermore, it is suggested that the most important functions of packaging are the communication attribute and the convenience attribute through eye-catching graphic which is suitable on shelf and attractive to consumers , while displays and communicates information about the products to consumers.(Niemelä-Nyrhinen and Uusitalo, 2013; Rundh, 2016; Sohrabpour et al., 2012; Thiendej and Chaipoopirutana, 2016). This leads to the requirement on filler company.

For the customer aspect, Ampuero and Vila (2006) classified the types of packaging component into two different types: the graphic component i.e. graphic, typography, graphical, and image, and the structural component which includes shape, size, and material used. This leads to the requirement on packaging supplier and retailer to support these demands. Furthermore, according to Ahmad et al. (2012), colour and

picture are the most important factors in affecting customer buying decision. Likewise, Mohebbi (2014) and Wells et al. (2007) argue that colour and graphic can influence the customer to buy a product, especially in a hurry.

- In addition, some customers prefer products whose labelled packaging contains many details, while others prefer one with less-detailed packaging due to time pressure and level of involvement (Silayoi and Speece, 2004). This made a concerning point to the focal firm. Additionally, in the environmental issue, customers tend to buy a product labelled as environmentally friendly if it does not affect the price (Martinho et al., 2015).

For the disposal agent, it requires end-users to segregate waste for the sake of efficient recycle process (Dangelico and Pujari, 2010).

All in all, all above requirements can be summarised into three main decision-making criteria, which are cost, regulation, and pollution. The connection between main actors and the decision making criteria is illustrated in Table 1.

Decision-making criteria

Table 1 Matching actors and decision-making criteria [1-3] setting importance

	Cost	**Regulation**	**Environmental concern**
Packaging supplier	2	1	3
Focal firm	1	2	3
Distributor	1	3	2
NGOs	3	2	1
Government	3	1	2
Customer	1	3	2

According to Figure 2, it can be seen that there are some difficulty and confusion of seeking relationship between actor of packaging value chain and its requirement. Table 1 is, therefore, generated to reduce a confusion by matching between main actors of packaging value chain with three crucial decision-making criteria. The significance of each criteria was setting as 1-3 (1 is the most important, and 3 is less important) to be easy to understand. The main actor of packaging chain, which is derived from many studies, consist of packaging supplier, filling or manufacturing company, logistics service provider, retailer, consumer, government, and NGOs (Vermeulen et al., 2013; Niemelä-Nyrhinen and Uusitalo, 2013; Dani, 2015). While three crucial decision-making criteria are derived from the existing study which consider these three characteristics i.e. cost, regulation, and environmental concern as the basic of decision making criteria (García-Arca et al., 2014; Vermeulen et al., 2013; White et al., 2015).

Details of the main actors in packaging supply chain, factors to be concerned in decision making, and sources are briefly explained in Table 2.

Table 2 Matching actors and decision-making criteria [1-3] setting importance

Actors	Factors	Sources
Packaging supplier	- The decision making criteria is related to manufacturer's requirements, cost attribute, and capacity attribute. - Policy, however, needs to be the most concerned rather than quality or performance for the packaging supplier.	Niemelä-Nyrhinen and Uusitalo (2013), Sohrabpour et al. (2012).
Focal firm	- It is necessary to consider production costs, manufacturing factors, and product requirements - For the regulation aspect, food packaging in Thailand may need to comply with the new standards proposed by the Thai Industrial Standards Institute (TISI) both compulsory and voluntary. Currently, the only mandatory TIS which affects the food industry is TIS. 51-2530 (1985) for canned pineapple	Rundh (2016), Thai Food Act (1987).
Distributor	- Cost of logistics which results from material selection, packaging size, and the number of packs per grouping need to be considered most carefully. - Promotion of renewable energy vehicle by NGOs and government are affecting the logistic decision in the food supply chain which lead to the distributors need to take environmental issues into account.	Dani (2015), García-Arca et al. (2014), Twede (1992).
NGOs	- For the NGOs such as Greenpeace, they are mostly concerned with the reduction of hazard and pollution in the world. - Also, the regulation seems to be the second most important criteria, for example, in the case of NGOs in India, namely the National Green Tribunal (NGT), which is finding a way to prohibit the use of plastic bottle as a packaging because heavy metal has been left over in a higher amount than the maximum level prescribed by the regulation, which could cause health problems to the users such as cancer and stroke.	White et al. (2015).
Government	- It concerns with the regulation and followed by pollution. - For example, the Ministry of Public Health is responsible for enforcing food law as a whole, and has the power to issue Ministerial Regulations for the implementation of the provisions of the Act.	Food and Drug Administration (1985).
Customer	- They are mostly concerned with cost aspect. - Apart from price, they prefers buying products labelled as environmental care particularly in the fast moving market e.g. food and beverages industry. This is supported that more than fifty percent of customers are finding an eco-friendly packaging in their purchasing behaviour.	Grubow (2007).

Conclusion

Even though there are some packaging decision support tools and programmes e.g. Packaging Impact Quick Evaluation Tool (PIQET), or The Waste and Resources Action Programme (WRAP); a benchmarking food and beverages packaging in the UK, there still have problems from the current tools that there is no an optimal trade-off between reducing the total cost of the supply chain and minimising total impact on the environment for the whole supply chain. For example, some of the actors might be concerned only about the cost which cause difficulty for others (Vermeulen et al., 2013). This is suggested that different needs and conflicts from the diversity of the supply chain organization which create unbalanced trade-off must be fulfilled (Sohrabpour et al., 2012).

A mapping of requirements in a sustainable packaging decision for actors of the supply chain has been proposed to understand the nature of that trade-off, in order to select an optimal trade-off which can reduce the total cost, mitigate total impact on the environment and social dimension, and identify the opportunities for a win-win solution of a whole supply chain further.

Recommend for future work

Based on the current problem, there is a gap in literature which require further research in order to generate a tool that can help packaging designer to decide the best decision for the actors of the supply chain under sustainable dimensions.

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