Correlated Key Attributes for Sustainable and Universal Design: A Case Study through Meal Packaging in Thailand

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Abstract

The study reports results of a series of research efforts to examine congruence between two design principles: universal and sustainable design concepts. The methods mainly adopted the focus group interview and the survey. A paper tray for fried chicken was used as an illustrative case to test the design attributes drawn out. The findings of the first stage indicated that the packaging executives agreed that both universal and sustainable designs played important roles in the current packaging trends and could be considered as integrative design. With explicit concern by companies over economic and environmental benefits, the package should also facilitate ease of use by consumers but retain its integrity and functionality. The design strategy for package reduction at the end phase of use after product consumption, was pointed out. At the second stage, package designers' points of view suggested the key design issues where consumer needs, environmental benefits and packaging functionality were all affected. At the final stage, responses to a questionnaire on the existing and proposed package designs for a fried chicken meal indicated that most consumers liked to use a paper tray for food products, despite the major problem of food leakage. The final findings indicated that the key structural factors of the proposed package with the correlated design attributes were easy handling and opening and facilitation of disposal. The extent of consumer satisfaction was subject to the right package structure and strength as well as clear information provided through graphics, pictures and symbols in order to provide guidance for disposal after use.

Keywords: Universal, Sustainable, Design attribute, Correlated, Packaging

Introduction

As societies around the world have become increasingly aware of environmental problems related to consumer consumption, solutions to alleviate such issues have been actively sought. More attention has been given to producing products that can claim to be "eco" or "environmentally friendly". Solutions that have been proposed or adopted to reduce adverse environmental impacts are often aimed at packaging, which could be considered an extrinsic attribute of a product. This is because most customers look at the packaging first of all and perceive the product's quality through the packaging prior to their purchase (Ampuero & Vila 2006; Becker, van Rompay, Schifferstein, & Galetzka, 2011; van Rompay, Deterink, &Fenko, 2016). From the customer's point of view, environmental friendliness may be evoked via the structure of a package and the graphical presentation on it, inducing them to make a purchasing decision. As a result, companies have directed intensive efforts toward producing packaging systems that are "sustainable".

While the definition of sustainable packaging remains unclear, simple packaging modifications, such as by decreasing the packaging weight per product unit or avoiding the usage of redundant materials, are often chosen. Other endeavors to respond to the concept of sustainability may include the control of harmful contributions to the environment throughout the packaging life cycle. One example of such activity by a large-scale business is Wal-Mart, which has developed an online system for their contract suppliers to adopt for calculating the

environmental impact of a product before certifying packages intended to be placed in the stores. Meanwhile, in Japan "green logistics" focusing on environmentally friendly packaging using recycled contents as a substitute for paper has been introduced.

The Sustainable Packaging Alliance (SPA) (2005). suggests that packaging should meet the following sustainability aspects. First, packaging should effectively benefit both society and economics. Secondly, packaging should use any source of materials, energy and water as efficiently as possible. Thirdly, packaging should be cyclically recoverable through industrial or natural systems. Lastly, packaging should be assured to be safe by not generating pollution or releasing toxicity into the environment throughout its life cycle (SPA, 2005). As a result, it can be seen that sustainable packaging should provide benefits not only from economic and environmental aspects, but also contribute in a positive way to society in general. Nevertheless, most present achievements for sustainability practices in packaging have merely focused on economic profits and environmental impacts (Svanes et al., 2010). As a matter of fact, packaging can have a valuable influence on society. This is because achieving sustainability in packaging depends not only to a large extent on consumers, but also through a supply chain from design to post-consumption management. Dominic, Östlund, Buffington, and Masoud (2015) proposed a sustainable packaging development model which integrated the design variables of technical, supply chain and environmental performance altogether and tested with a corrugated box. It is thus important not to overlook the social aspects, and necessary to explicitly bring out the true essence of sustainability via consumer interest and social equity (Nordin & Selke, 2010).

Packaging design consistently confers key benefits, not only to customers but also end users. Aside from the main role of packaging in the form of protection and preservation, packaging should be specifically designed for convenience and ease of use as well as clarity of information. In 1997, the concept of universal design was first introduced by the Center for Universal Design at North Carolina State University. It has been extensively applied at the design stage for a variety of modern products ever since. One main purpose of universal design is the aim of enabling all end users to use the product with ease, regardless of age, gender, and level of ability. In the context of packaging (Demirbilek & Demirkan, 2004; Duizer, Robertson, & Han, 2008; Fuente & Bix, 2006; Garmer, Sperling, & Firsberg, 2002; Tangam, 2012; Valeethorncheepsawad, 2008; Yiangkamolsing, Bohez, & Bueren, 2010), the implementation of universal design can be described as follows. Packaging should facilitate the ease of identifying the product within. These days, packaging, to fit into the emerging modern lifestyle, should be easy to hold/carry and allow an individual end user to easily open it to access the product within. As the informational elements, such as logos and iconic presentations, often influence consumer recognition of a product (Magnier, Schoormans, & Mugge, 2016), packaging can also offer consumers and end users a way to understand the product/packaging system properly. Moreover, in addition to the significant role of packaging in protection and preservation of the product contained, it is necessary that packaging be able to be stored conveniently. It also is suggested that a sustainable packaging should be considered as a continuous optimization in combination for the food product for which it is designed in order to prevent food losses and waste through-out the supply chain (Williams, Wikström, & Löfgren, 2008; Grönman et al., 2012; Molina-Besch, 2016). At the waste phase, after the product is consumed, packaging ideally should be easily disassembled, rather than being discarded whole, before being disposed of without generating any harm to the environment and community.

Although sustainable and universal designs each comprise many valuable points, there appear to be distinct differences between the two principles. However, in our view correlations between them do exist for certain design attributes. In essence, both sustainable and universal designs are responsible for satisfying social needs. The objective of this work is therefore to elicit the key design attributes representing the correlation of both design principles. To this end, two packaging prototypes were developed to exemplify through the correlated design attributes of the two design principles in order to ensure that the intersection of the so-called "three pillars" – economic profits, and environmental and social contributions – can be achieved.

Methods and Materials

The study comprised three stages. In the first stage, focus group interviews were conducted with a group of ten executives involved in the leading packaging industry in Bangkok and its vicinity. The objective of this procedure was to consolidate in-depth opinions and viewpoints toward the two principles: universal and sustainable designs for packaging. This, in general, is because packaging executives are usually a key mover to derive the packaging design process as well as the innovation toward the physical and communicative aspects to the market-driven demands. They are responsible for planning in-depth understanding and impose packaging strategies concerning not only consumers' needs, but also the stakeholders' expectations, logistics processes, avoidance of over usage of packaging materials, packaging manufacturing and machinability as well as environmental performance of the propose packaging (Vernuccio & Cozzolino, 2010; Pålsson & Hellström 2016; García-Arca, Garrido, & Prado-Prado, 2017). The invited executives were carefully selected according to their expertise in packaging and overall experience. The participating executives are listed in Table 1. A three-hour session was guided by a list of open-ended questions within the discussion framework. The ideas and comments were recorded and collected for all of the interactions. Without aiming for a precise measurement, the focus group method rather gains in-depth knowledge on certain points. Those points are especially useful for learning the conceptualization of particular phenomena by the focus group participants (Blackburn & Stokes 2000; Jinks & Daniels, 1999). Although the following three generic questions were delivered in Thai language at the time, they have been translated into English here in this work to obtain the research outcomes. The questions are:

Q1: How is universal design important to packaging in Thailand?

Q2: Should sustainability be taken into consideration during the packaging design stage?

Q3: Are there any issues or attributes of universal and sustainable designs for packaging that should be of concern?

Table 1 Ten packaging executives chosen for the focus group.

Participants	Affiliation
Department Head, packaging designer and educator	Department of Art and Design, Naresuan University, Phitsanulok
Chairman, eco-material and bio-based plastics manager	Thantawan Industry Public Co., Ltd., Bangkok
Department Head, flexible packaging and universal packaging designer	Faculty of Engineering, University of the Thai Chamber of Commerce, Bangkok

Table 1 (Cont).

Participants	Affiliation
Manager, packaging technical specialist	Thai Packaging Centre (TPC), Thailand Institute of Scientific and Technological Research, Bangkok
Managing Director, ecological designer	Eco Design Consultant Co., Ltd., Bangkok
Honorary Advisor, management and packaging design for consumer products	Thai Packaging Association, Bangkok
General Manager, packaging printing and folding carton converting technology	Siam Toppan Packaging Co., Ltd., SamutPrakan
Sales and Marketing Manager, packaging printing technology	Kim Pai Co., Ltd., Bangkok
Department Head of Packaging Design, corrugated container	Thai Containers Group Co., Ltd. (SCG Packaging), Bangkok
Department Head of Packaging Design, glass packaging	Bangkok Glass Industry Co., Ltd., Pathum Thani

At the second stage, the constructive findings from the focus group participants were consolidated and analyzed by the content analysis method to form a subsequent questionnaire for packaging designers. This is partially because an array of guidance for designing packaging products is usually conveyed through the hierarchical levels of an organization. The questions were constructed not only based on the focus group findings, but also from relevant literature reviews. Quota and purposive samplings were also used at this stage. There were a total 91 respondents to the questionnaire. Their heterogeneity profile was:

- Gender: male 53.8%; female 46.2%.
- Design expertise: structural packaging designer 59.2%; packaging materials designer 14.8%; graphic designer 26%.
- Education: college certificate 3.3%; bachelor's degree 87.9%; postgraduate degree 8.8%.

The packaging designers comprised three groups: 31 from the industrial sector, 30 from the academic sector, and 30 packaging contest awardees by prominent organizations and institutes in Thailand. The results were statistically analyzed by a factor analysis. Statistical calculation employed an orthogonal rotation procedure (varimax with Kaiser normalization) (Vanichbuncha, 2005). The method congregates new variables known as "key factors". The correlation of those factors is determined and the most significant factor among the others is also identified. The obtained findings reflect the correlation of both design principles.

The third stage included the development of two packaging prototypes according to the correlated design factors of both universal and sustainable packaging designs. This was to ensure that end users and consumers would be satisfied with the effectiveness of the subsequent packaging. Packaging in the form of a paper tray for a fried chicken quick-meal was used as an example. This is because consumption of quick-meal menus has continually grown in Thailand, especially in big cities like Bangkok and the surrounding vicinity.

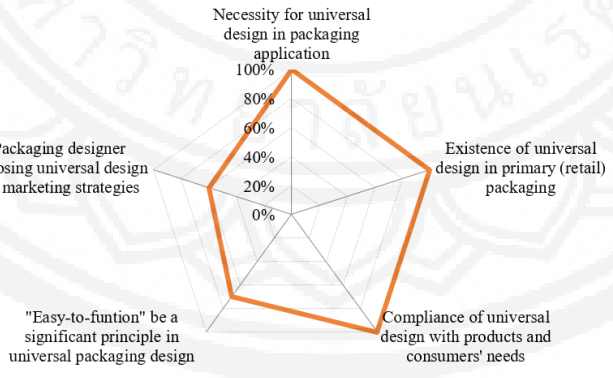
At this stage, the design attributes were first drawn forth according to the design factors synthesized from the factor analysis. Later, the packaging prototypes were evaluated by consumers via a questionnaire to ascertain their viewpoints toward the packaging redesign and to underpin the correlated universal and sustainable designs. More than 400 participants were involved in the survey. The number of sampled participants was calculated using the method developed by Yamane (1973). The socio-demographic profile of the questionnaire respondents was:

- Gender: male 51.1%; female 48.9%.
- Age: < 20 years 12.9%; 20–30 years 74.2%; 31–40 years 12.2%, > 40 years 0.7%.
- Occupation: student 61.5%; employee 20.1%; government official 9.9%; business owner 8.5%.
- Living status: single and living with family/roommate 63%; living alone 34.3%; N/A 2.7%.
- Monthly income (in US$): < $141.4, 27.3%; $141.5–282.8, 32.8%; $282.9–565.6, 27.3%; $565.7–848.4, 11.7%; > $848.5, 1% (referred to comparative exchange rate in December 2013, US$1 ≈ 35.36 Thai baht).

Results and Discussion

Findings from the focus group interview with packaging executives on universal and sustainable packaging designs

The findings of the ten packaging executives regarding universal design and sustainable design for packaging are illustrated in Figure 1 and can be summarized as follows. The executives agreed that it is necessary for universal design to be integrated into every level of packaging development and application (n = 10). This is because within the next 5 to 10 years Thailand will have become an "ageing society". Although universal design has been mostly applied in primary/ retail packaging, most Thai consumers still lack a comprehensive understanding of the definition of universal design (n = 10). The principles and design attributes of universal design are known only within a limited group, and relatively few have chosen to employ them. The packaging industry in Thailand has focused almost exclusively on designs for facilitating packaging for products and consumers (n = 10). Those involved the functional design of packaging should ensure that it provides ease of product identification, product accessibility and usage (n = 7). To achieve this, the structural and functional characteristics of packaging, together with the product, should be taken into consideration during the design stage (n = 6).



(a)

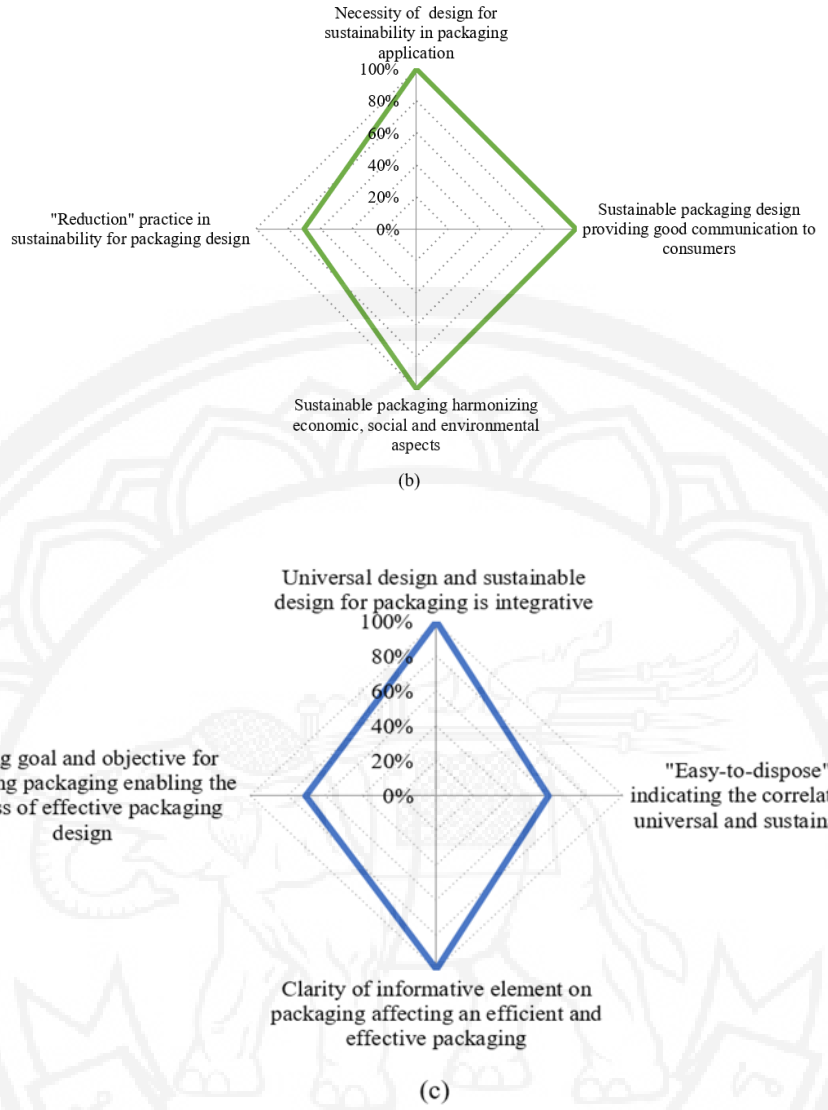


Figure 1 Attitudes of Thai packaging executives toward universal and sustainable designs for packaging: (a) universal packaging design; (b) sustainable packaging design; (c) relationship between universal and sustainable designs

The executives also suggested that packaging forms and shapes should conform to consumer ergonomics. Nevertheless, it may be necessary for packaging designers to be aware of conflicts that may arise during the attempt to balance various design attributes. For instance, a well-designed closure of a bottle which is believed to accommodate the openability may in fact bring adverse complexity to the manufacturing process of the closure. All interview participants agreed that the universal design should, whenever possible, harmoniously accommodate different groups of targeted consumers. In order to achieve success in designing a package, the graphics and images on the packaging providing any kind of information should be unambiguous and comprehensible (Magnier & Schoormans, 2015).

With increasing awareness of environmental issues in recent years, the importance of sustainability has emerged. The packaging executives agreed that the concept of sustainability, despite lacking clarity, would be necessary to apply in the packaging design phase (n = 10). They even pointed out that a reduction in packaging has become one of several strategies involved in the sustainability spectrum (n = 7). Reducing packaging components, materials and dimensions can be targeted. Such practicable actions conform to the resource

efficiency recommendations in the 2011 sustainable packaging guidelines of the Australian Packaging Covenant. However, the format of sustainable packaging design is favorable if it will not result in an adverse impact on manufacturing costs (n = 10). The executives believed that a complex design usually generates an increase in production cost. However, packaging which is designed with the sustainability concept will be beneficial to society if the advantages can be comprehensively communicated to all consumers, indicating the potential benefits that can be gained from such so-called sustainable packaging (n = 10).

Finally, the executives indicated that they could perceive the correlation between universal design and sustainable design for packaging as an integrative design (n = 10). They agreed that a design attribute explicitly indicating the correlation of both packaging design principles should emphasize the ease of disposal at the waste phase of packaging (n = 6). In theory, it is strongly suggested that packaging design for sustainability must satisfy "three main pillars" – social, economic, and environmental – whereas universal design should ensure that all types of consumers are accommodated. However, it usually occurs to the managers of a business that sustainable packaging often increases various costs, typically involving innovations in materials and technologies. This is a potential drawback that can have tremendous effects on a business's profits and direction. Although the fundamental satisfaction of society should be kept in mind throughout the design process, balancing a design task to include the three main pillars may be problematic. As a result, it is essential for an organization that its policy makers, personnel in research and development, and packaging designers should work together as a team to bring forth the design solutions (n = 7). Otherwise, the packaging designers may be wandering in a maze and end up with an inefficient design at the end.

Factors contributing to universal and sustainable designs for packaging

The constructive findings from the first stage were consolidated to form the subsequent questionnaire for packaging designers. Ninety-one packaging designers were asked to respond to the questionnaire. The results were collected and synthesized using factor analysis. The factors relating to universal and sustainable packaging designs were congregated. Using the orthogonal rotation approach, the statistical scores of the factors were obtained. According to analysis using the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy, the test score obtained was 0.762. The theoretical assumption is that the sample size for the factor analysis would be reasonable if the KMO value was greater than 0.5. With the KMO value determined as such, the proposed sampling was thus deemed acceptable. In addition, the obtained KMO value was close to 1.0, indicating good suitability of the factor analysis. Bartlett's test of sphericity also indicated that the chi-square value was 216.696. Therefore, all factors were correlated, and the factor analysis approach could be used further.

There were nine design factors for packaging corresponding to the responses of the designers:

- Structure: The structure of the package should be in accordance with the ergonomics of all users.
- Presentation: Graphics and descriptions on the package should provide understanding of the product to consumers.
- Size: The proper size and dimensions of the package should comply not only with the quantity and volume of the product contained, but also the extent of consumer consumption.
- Ease: Ease of folding and/or disassembly for disposal is desirable.
- Comprehension: Graphics to indicate a disposal method may be more practical than lengthy descriptive information.

- Universality: Graphical presentations such as recycling and Mobius symbols should be used to identify the packaging material for disposal management at the waste phase.
- Decoration: Effective printing techniques attract both product producers and consumers. Printing colors may be used for differentiating tastes and favors of the product. However, the number of colors used should be kept to a minimum.
- Functionality: The strength of the packaging should be maintained if the package is restructured by a change in the material used or a reduction in thickness.
- Satisfaction: Additional materials such as reinforcements and additives can be used for the purpose of reducing the main packaging materials and/or offsetting the material properties where deficient. However, the resultant packaging still needs to satisfy the requirements of both product producers and consumers in terms of strength and function.

Table 2 Loading scores of the nine design factors contributing to integrative design for packaging; obtained from factor analysis with the rotation method (varimax with Kaiser normalization)

Emerging factors	Consumer-related	Environment-related	Packaging function-related
Structure	0.861	- 0.048	0.034
Presentation	0.656	0.233	- 0.038
Size	0.646	0.202	0.355
Ease	0.635	0.405	0.1
Comprehension	0.106	0.853	0.125
Universality	0.233	0.786	0.084
Decoration	0.187	0.538	0.433
Functionality	0.003	- 0.001	0.906
Satisfaction	0.139	0.355	0.71

Table 2 lists the scores of each factor (with key factors highlighted in color) in relation to three categories – consumer-related, environment-related, and packaging function-related – and shows the statistically calculated results obtained by the factor analysis. The orthogonal rotation approach (varimax with Kaiser normalization) was applied for the axes of factors of universal design and sustainable design. This yielded the factor with the highest score (loading). Based on the analysis, the nine factors related to packaging design can be categorized into the three abovementioned groups, as illustrated in Fig. 2. The factors with the highest scores indicate a significant correlation of both universal and sustainable designs; hence, the integrative design for packaging.

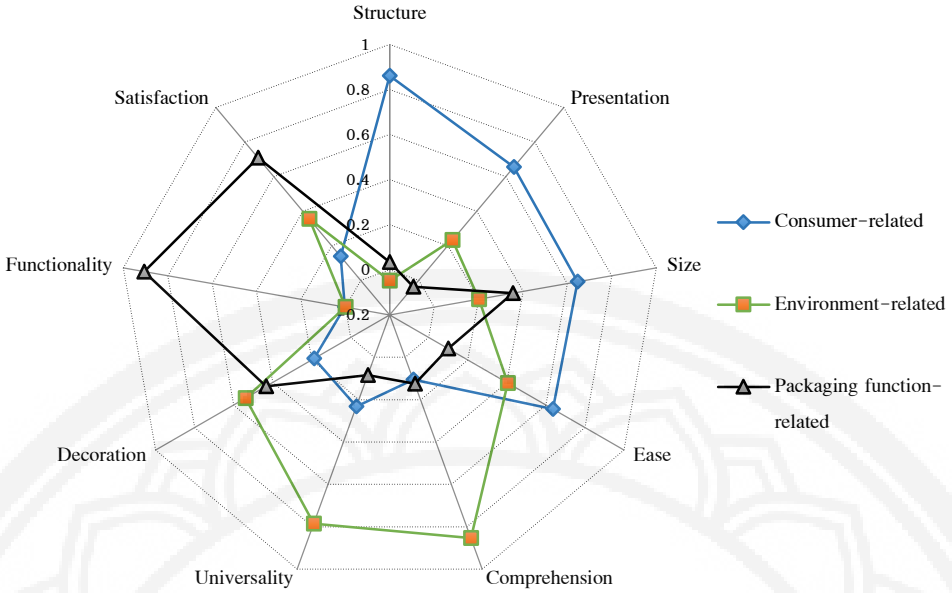


Figure 2 Factors contributing to integrative packaging design

The illustration and scores provided suggest that the factors which responded to consumers' needs include the structural design of packaging, graphical presentations on packaging, size and dimensions of packaging, and ease of disposal, respectively. Designing packaging with the proper structure in accordance with the ergonomics of all users attained the highest loading score (0.861). In addition, in order to respond to environmental requirements, designing a package with a comprehensive graphical presentation is preferable (rather than a lengthy written description) for conveying information concerning practical disposal methods for packaging at the end-of-use phase (score = 0.853). Lastly, and perhaps most importantly, the functionality of packaging is the principal factor that a business should take into account, to ensure that the product within will be protected throughout the distribution system and arrive in the consumer's hands in a sound and acceptable condition. Restructuring packaging by changing the material or reducing the thickness may be allowed whenever necessary. Nevertheless, it is essential that the packaging will retain its functionality as required for protection of the product within (score = 0.906). It is worth noting that, from the packaging designers' perspectives, the structural design and functionality of packaging are not relevant to the environmental aspect. This can be observed by negative scores of those factors. Similarly, the graphical presentation on packaging has no significant relationship to the packaging functions.

Prototyping packaging with correlated attributes between universal and sustainable designs

Packaging in the form of a tray for fried chicken was chosen as an illustrative case to test the integrative packaging design in this study. Based on the three key design factors identified from the previous stage, i.e. structure, comprehension and functionality, it was then necessary to elicit the design attributes corresponding to the individual factors. Two packaging prototypes were designed and proposed at this stage. Based on a literature review, it was found that paper packaging is preferred by most consumers because paper is foldable and biodegradable (Triantafyllou, Akrida-Demertzi, & Demertzis, 2007). Furthermore, paper packaging is favored by the public for food products.

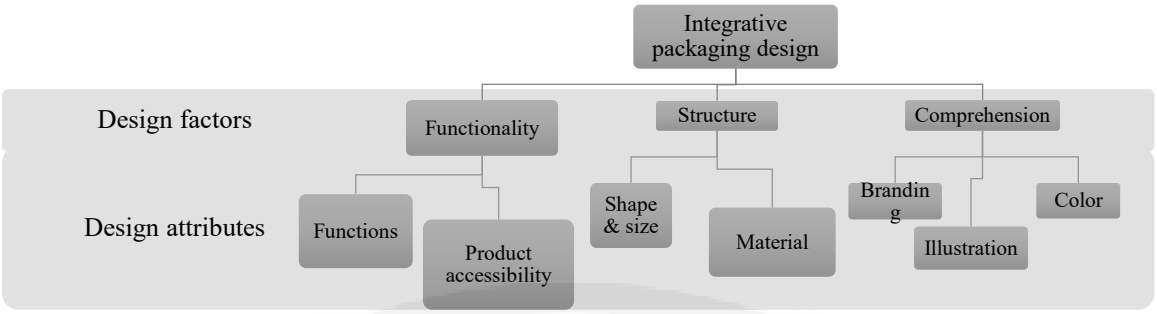


Figure 3 Design attributes subjected to design factors for integrative design for packaging

Figure 3 depicts the design attributes and features responding to the three factors. It can be seen that the thinking process followed the hierarchical importance based on the scores obtained by the varimax with Kaiser normalization approach, as mentioned above. The resulting packaging prototypes are illustrated in Figure 4. Details of the design features of the packaging prototypes are as follows.

The material used was a 240-gsm white cardboard that can be folded into a square-shaped tray designed to fit the consumer's hand for easy holding. The cardboard was coated with a biodegradable polymer to make the tray semi-rigid and help prevent spills and leakage. The size of the fully opened tray was 17 × 17 × 6.6 cm (W × L × H). The form of the tray offers consumers convenient access to the food, while the foldable shape allows consumers to reduce the size of the tray after food consumption prior to disposal. Along with any food waste, used utensils and paper napkins can be placed into the tray before folding and discarding it.

The two-color offset printing used soy-based inks to promote consumer friendliness and low environmental impact. The background color was printed in orange to convey a sense of deliciousness and stimulate the appetite of the consumer, while red symbolically represented fresh cooking and spiciness of the food. Information on the tray included the "Tasty Tasty" brand name to attract and communicate with the consumers. Also, simple graphics and fonts were chosen to aid in consumer understanding. An additional phrase, "Enjoy eating, Enjoy disposing", was intended to raise consumer awareness about proper disposal of the tray after the food is consumed. Pictorial features indicating the folding method were also located on the side of the tray.


17 cm
14 cm
Top view
Bottom view
Front view
Right Side view
Rare view
Left Side view

(Prototype A)

Figure 4 Variants of the proposed packaging prototypes contributing to integrative packaging design

After completing the process, several packaging designers were asked to evaluate the resulting design. This was to confirm that the design compiled with the factors from the perspective of integrative packaging design. Tables 3 and 4 summarize the evaluation results.

Table 3 Summary of the evaluation by packaging designers on the design attributes

Features corresponding to the design attributes	Structure	Comprehension	Functionality	Intersection of universal and sustainable designs
Accessible to the food	✓	-	✓	✓
Easy to reduce packaging size after eating	✓	-	✓	✓
Square-shaped tray	✓	-	✓	✓
Fits consumer ergonomics and is easy to hold	✓	-	✓	✓
White cardboard coated with biodegradable polymer	✓	-	✓	✓
Offset printing with soy-based inks	-	✓	-	✓
The "Tasty Tasty" brand name stimulates the consumer's appetite	-	✓	-	✓
Pictorial presentations convey understanding of food packaging	-	✓	-	✓
Clarity of graphical presentation for introducing the folding method	-	✓	-	✓
The slogan "Enjoy eating, Enjoy disposing" raises consumer awareness of packaging waste management	-	✓	-	✓
Fonts are clear for communication with consumers	-	✓	-	✓
Printing colors convey the spicy and fresh-cooked characteristics of the food	-	✓	-	✓

Table 4 Measurements and descriptive statistics of design description where the highest rating was achieved

Design principles	Corresponding features	Design guidelines	Likert scale (1 = least preferable; 5 = most preferable)
Universal design	Easy to identify	Graphics and images facilitate disabled consumers	4.82 ± 0.383
	Easy to hold	Shape, weight and size of packaging fit the product	4.63 ± 0.571
	Easy to open	Explicit position for opening the package	4.69 ± 0.552
		Graphics and images to locate the opening position	4.69 ± 0.464
	Easy to take out	Clear instructions for using the product	4.85 ± 0.363
	Easy to understand	Details and informational elements enabling the instructions for usage	4.65 ± 0.480
	Easy to use	Structure of package facilitating functionality	4.57 ± 0.540
	Easy to store	Features facilitating the reopen- and reclose-ability	4.75 ± 0.508
	Easy to dispose	Biodegradable material usage	4.47 ± 0.689
	Injury prevention	Features to prevent injury caused during usage	4.59 ± 0.537
Sustainable design	Fit for purpose	Designing packaging with recyclable materials as much as possible	4.47 ± 0.491
	Resource efficiency	Reducing packaging materials without restricting packaging functionality	4.63 ± 0.551
	Low-impact materials	Selecting packaging materials with low environmental impacts but not affecting marketing profits, functionality, product protection and preservation, as well as user-friendliness	4.45 ± 0.522
	Resource recovery	Designing packaging with the aim of reducing packaging waste	4.30 ± 0.641

Next, viewpoints from Thai consumers on the redesigned fast food packaging were sought. There were 403 respondents to the questionnaire. The questionnaire was first tested to confirm the reliability of the research tools. Later, a statistical method was used to calculate Cronbach's alpha coefficient, yielding a value of 0.917 which indicated that the questionnaire was proven to be reliable.

In the questionnaire, the respondents were first questioned on points that make them unsatisfied toward the existing packaging presently available in the market. Figure 5 presents those unsatisfactory issues. A majority of the respondents complained that when they used paper trays the containers often leaked and made their hands dirty (87.1%). This may be caused by the insufficient grammage and thickness of the paper used. Most consumers shared the opinions that packaging for food should provide, if possible, not only convenience for holding and accessing the food (53.8%), but the materials used should also have sufficient strength to prevent leakage or spills during consumption (40.2%). In addition, the packaging should be illustrated with graphical presentations clearly indicating an easy-to-follow disposal method (6.5%).

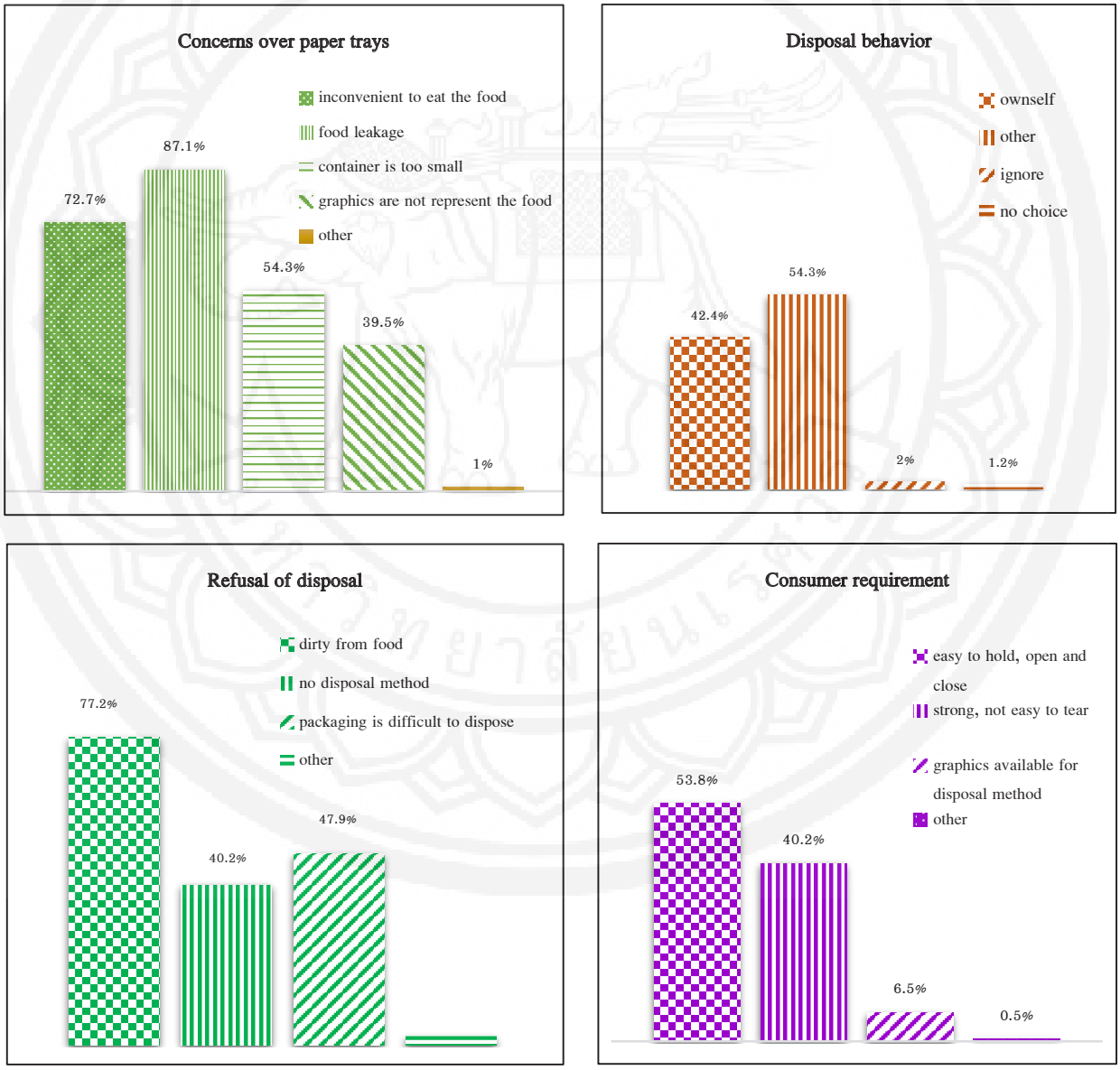


Figure 5 Opinions of consumers toward food packaging presently available in the market

With the opinions above, the respondents were then requested to evaluate the two proposed redesigned paper trays for fried chicken based on their preference and favorability. Table 5 compares the measurements and descriptive statistics of their preferences. The first package prototype had a higher rate of consumer satisfaction than the second, with the most preferred feature that the proposed tray be easy to open/close and use.

Table 5 Comparison of descriptive statistical results of the packaging prototypes, by consumers.

Descriptions	Prototype A	Prototype B
Ease of handling, opening, closing and using	4.29 ± 0.655^{a}	3.85 ± 0.709^{b}
Packaging structure, tearing strength and leakage resistance	4.10 ± 0.785^{a}	3.92 ± 0.787^{b}
Graphical presentation and symbols indicating clear guidance for disposal	4.13 ± 0.747^{a}	3.97 ± 0.734^{b}
Overall satisfaction	4.20 ± 0.725^{a}	3.88 ± 0.743^{b}

[a,b]Significant differences at a 95% confidence interval ($p<0.05$) are denoted by non-commonsuperscripts in the same row.

Conclusion and Suggestions

This research aimed to elicit the design attributes representing the correlation between sustainable and universal designs for packaging. This is because both principles play important roles during the packaging design stage these days and are correlated in some ways. The packaging executives involved in the focus group agreed that packaging design in Thailand should be looked upon as integrative design. Not only does packaging need to positively affect the consumers who are using it, but also the environment, reducing the negative impact while maintaining product functionality. The intersection of the two design principles suggested that packaging should provide ease of disposal at the waste phase of the packaging's life cycle. In order to achieve that, clear informational elements and pictorial representations on the packaging should enable consumers and users to understand how to use the packaging properly and dispose of the waste effectively at the end of its life cycle. A symbol indicating the material type may be helpful for sorting the packaging waste in the further recycling process. The appropriate structure of the package, including its shape and size, not only assists consumers in holding it, but also the workers and personnel involved in the logistical system as a whole. Modifying the structure of the package by adjusting the thick- ness or introducing a new material to use may be implemented. But it is necessary to ensure that packaging strength is maintained in order to accomplish the fundamental role of packaging functionality, the protection and preservation of the product within.

General implications

The definition of sustainable design of packaging remains unclear but is an important concept for business these days. Design strategies for sustainability become meaningful when the design meets all of the three pillars of the sustainability concept. Thus, consideration of or focus on a packaging design that responds only to economic and environmental benefits is insufficient; the packaging should be also completely fulfill its role of functionality. With an increasingly ageing society around the globe, packaging should provide convenience and ease of use for all customers and users. This is where universal design for packaging comes into play, boosting the competitive capacity to influence the customer's purchasing decision.

Though the packaging system comprising the entirety of primary, secondary and transport packaging should be addressed, only primary (retail, sales or consumer) packaging was highlighted. The findings presented indicated that packaging functionality, structure and customer/user comprehension are crucial and should be kept in mind throughout the design and development process. In other words, the values of packaging to the consumer can clearly be influenced by packaging design conveyed the descriptions of functional and communicative, emotional and critical cost/benefit evaluation offerings. This is because these can instill positive perceptions toward the business and its product. More specifically, the results showed that the shape and size as well as the material used in a package may also inspire confidence in the integrity of packaging functionality, i.e. for product protection and ease of product accessibility. Furthermore, the results presented indicated that clear informational elements, graphics and images, as well as symbols, aid in consumer comprehension of the packaged product and provide ideas for managing packaging waste after product consumption, thereby supporting the essence of sustainable and universal designs across all users.

With respect to practical implications, the results are promising in so far as they provide practical guidelines for packaging design. These enable not only designers but also professionals in the packaging industry to come up with the right package for their products. However, one limitation of the present study is that it is experimentation-based empirical research in which a single illustrative case is used. The purpose of the study is only to test the correlation of design attributes of the universal and sustainable design principles. The actual respondents may not represent the general population. The perceptions expressed are for a given group of users. Looking ahead to future research, it might be possible to extend the analysis to consider different groups of respondents, e.g. those with disabilities, in order to analyze different outcomes of the packaging impressions through the informed design decisions.

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