

**Identifying packaging criteria for sustainable
packaging design and development:
Towards packaging efficiency and packaging
integration in the fruit juice industry of South Africa**

by

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Declaration

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Abstract

It is difficult to satisfy all the needs of customers in a competitive industry such as the fruit juice market in South Africa. Customers may be dissatisfied with the product for different reasons, which is of concern for both retailers and product manufacturers. However, if customers are dissatisfied with the product and the packaging design, the concerns could be elevated to higher levels in the supply chain hierarchy until they reach the packaging manufacturers.

To avoid customers' dissatisfaction with the product, considerations should be made to identify the weaknesses of a product. Addressing these weaknesses is sometimes not possible or they are too expensive to address. Therefore, since the primary packaging is a component that comes in direct contact with the product, the next best option would be to make changes to the packaging design or even to develop a whole new packaging system. There are various references towards problems with the specifically chosen fruit juice packaging in South Africa.

Two different research strategies are used to address these packaging problems. The first strategy involves identifying which part of the packaging, i.e. which packaging criterion, should be addressed by using a packaging evaluation model. When the most suitable evaluation model is eventually chosen, the weaknesses of the packaging can be identified by using this said model. Consumers and retailers are the key role players in identifying these weaknesses through the use of the evaluation model. The second strategy will make use of secondary data analysis in order to theoretically develop a packaging design and development process in order to make the required changes to the identified criteria while considering sustainable packaging.

Ultimately, this study uses the packaging scorecard to identify the criteria on which the product performs poorly. Three criteria are identified. A packaging design and development process is developed to address the three packaging criteria in order to make the changes required for an improved packaging design.

Opsomming

In die kompeterende vrugtesapbedryf van Suid-Afrika is dit moeilik om verbruikers se behoeftes te bevredig. Verbruikers kan weens verskeie redes ontevrede wees met produkte. As gevolg hiervan, word kommer gewek by en druk geplaas op beide handelaars en produktevervaardigers. Indien verbruikers egter ontevrede is met beide die produk en die verpakking van die produk, strek die aanspreeklikheid baie hoër op in die hiërargie van die voorsieningsketting tot by die verpakkingsvervaardigers.

Om ontevredenheid by die verbruiker te vermy, kan produksievervaardigers dit oorweeg om die swakpunte van die produk te identifiseer. Dit is egter soms te duur of onmoontlik om veranderinge te maak aan die produk. Aangesien die primêre verpakking direk in kontak met die produk kom, sal die naasbeste opsie wees om veranderinge aan die verpakkingsontwerp aan te bring of 'n hele nuwe verpakkingsstelsel te ontwerp. Daar is verskeie referente wat aandui dat daar probleme is met betrekking tot die spesifieke vrugtesapverpakking in Suid-Afrika.

Twee verskillende navorsingsstrategieë word gebruik om die drie probleme aan te spreek. Die eerste strategie identifiseer watter dele van die verpakking, d.w.s. verpakkingskriteria, verbeter kan word deur middel van 'n evaluasiemodel. Sodra die beste evaluasiemodel gekies is, kan die swakpunte van die verpakking geïdentifiseer word deur van die gekose evaluasiemodel gebruik te maak. Verbruikers en handelaars is die rolspelers wat die swakpunte identifiseer met die evaluasiemodel. Die tweede strategie sal gebruik maak van sekondêre data analise om 'n teoreties verpakkingsontwerp- en ontwikkelingsproses te ontwikkel om die veranderinge aan te bring soos geïdentifiseer deur die evaluasiemodel terwyl volhoubare verpakking in ag geneem word.

Hierdie studie maak vervolgens gebruik van die verpakkingstelkaart en identifiseer die kriteria waarin die verpakking die swakste gevaar het. 'n Verpakkingsontwerp- en ontwikkelingsproses word geïdentifiseer wat die drie swakpunte aanspreek en uiteindelik die verpakkingsontwerp of die verpakkingsstelsel kan verander en/of verbeter.

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Chapter 1: Introduction

Packaging Logistics aims to contribute to a sustainable society as it integrates product and packaging development, innovation, and supply chain management from economical, technical, and environmental life cycle perspectives (Lund University, 2009, s.v. 'Packaging Logistics'). Packaging can be defined as "the technology and art of preparing a commodity for convenient transport, storage and sale" (Encyclopaedia Britannica, 2003, s.v. 'packaging'). Over the years packaging has been seen as an inescapable cost that adds no strategic value to the product in the supply chain (Lockamy III, 1995). However, if implemented correctly, packaging will add much more value to the product in the supply chain (Klevås *et al.*, 2012).

Product packaging should lure the consumer in and at the same time be innovative (Pålsson *et al.*, 2011). A customer's perception towards a packaging design is very important and can contribute toward the product being bought and consumed or not (Bramklev & Hansen, 2007c). Packaging design implies that a specific package consists of unique packaging criteria (Pålsson, 2012). Although some packaging designs may share the same purpose, the design specifications are different. Since consumers' decisions are mostly influenced by emotion, packaging design has become a vital component of the marketing strategy and success of a product (Cape Business News, 2015).

Packaging can be seen as part of the product and if combined with the product, it represents the four P's of marketing (price, product, place and promotion) (Beckeman & Olsson, 2012). Successful packaging is therefore of the utmost importance (Magnusson *et al.*, 2012). To improve customer experience, decisions about packaging should be made (Bramklev, 2007). When packaging decisions and evaluations have been made, it should be determined if the current design should be modified or if a new packaging design should be created (Pålsson *et al.*, 2011). After identifying what should be changed, the packaging can go through a packaging development process to enhance the customer experience and to gain a competitive advantage in the market (Olander-Roese & Nilsson, 2009).

In the ever increasing population around the world, challenges will arise regarding the demand for food supply (Godfray *et al.*, 2010). One way to deal with this problem is to reduce food waste (Parfitt *et al.*, 2010). One of the measures that can contribute to the reduction of food waste is packaging improvements (Sohrabpour *et al.*, 2012). In addition,

packaging improvements can increase the supply chain efficiency and effectiveness (Olander-Roese & Nilsson, 2009). The heart of a manufacturing company is its product development (Casell, 2011) and therefore it is important to consider packaging development and product development as an integrated system (Bramklev, 2007; Olander-Roese & Nilsson, 2009).

Packaging design improvements can create new perspectives on how to add customer value and improve sales through packaging (Olander-Roese & Nilsson, 2009). Companies should consider where consumer insights will guide them, which issues are important to the retailers and consumers regarding the packaging, how much they spend on packaging (from material to the design and logistics), and what the role of the supplier is in the development process (Olander-Roese & Nilsson, 2009). Packaging should connect with the consumer and make the product more desirable and accessible in terms of handling and looks (Taylor & Ross, 2013). Packaging should not be seen as a single object, which forms a whole, because packaging is present throughout the entire supply chain (Sohrabpour *et al.*, 2012; Pålsson *et al.*, 2011). In addition, the product development process integrated with the packaging development process can ultimately affect logistics activities throughout the whole supply chain (Bowersox & Closs, 1996; Bramklev, 2007) and therefore it can be beneficial to consider incorporating new packaging designs.

Packaging development should provide solutions for the product that will complement and support the product during part of its life cycle (Bramklev, 2007). A product's life cycle can be regarded as the entire history of its existence (Bramklev, 2007). This includes the finalisation of the product's manufacturing until the product (in this case) is consumed and the packaging is disposed of or re-used (Bramklev, 2007). Packaging design and development can play a key role in product innovation, marketing innovation, and process innovation (Klevås *et al.*, 2012; Olander-Roese & Nilsson, 2009).

In a survey conducted by Olander-Roese and Nilsson (2009) among 24 respondents it was concluded that achieving a high marketing potential was more important than decreasing logistics costs – especially for producers and retailers. Furthermore, new product and packaging development is important for companies to be competitive (Roozenburg & Eekels, 1995). Packaging innovation, however, holds great potential for all the actors in the supply chain (Olander-Roese & Nilsson, 2009). The purpose is to provide a packaging solution of packages with different materials and sizes to be combined for the best possible packaging solution, which may improve the product design, production process, material handling,

logistics, packaging machinery, and supplier relations (Bramklev, 2007; Olander-Roese & Nilsson, 2009).

All of the above-mentioned are factors that can influence packaging efficiency (Pålsson, 2012). Packaging efficiency can be defined as the ease of handling, logistics, traceability, protection, or anything related to the physical attributes of packaging affecting the supply chain directly (Olander-Roese & Nilsson, 2009; Sohrabpour, 2012). Therefore, when making decisions on packaging design and development, it is important to consider the effects it will have on packaging efficiency and ultimately the whole supply chain (Sohrabpour, 2012).

Chapter one aims to outline the background of the packaging logistics field and how the problem statement arises. This chapter is split into nine sections. Section one discusses the background of this research. Section two contains a preliminary research design and methodology. Section three and four identify the research problem and the research questions. Section five, six and seven discuss the relevancy, aims and objectives of this research respectively. Section eight covers the limitations that could arise while conducting this research. Finally, section nine will provide a brief overview of all the chapters in this research.

1.1. Background

According to Bramklev (2007), differences in terminology occur in the field of packaging. In order to ensure lack of variation, the package can be considered an engineered artefact and can be classified as an extension of the product and for the sake of this research will be referred to as “packaging”. This means that the features and performance of the product are supported by the package with which it is identified. This plays a big role in some parts of the product life cycle. Bramklev (2007) further explains that the term packaging can be considered to indicate the process of producing and packing the package or the package system. The term product refers to the content of the package (in this case fruit juice). Lastly, packaging design and development is the development and or design of an object termed packaging.

In order to understand to what dimensions and perspectives a change to packaging can occur and what improvements it will have, all the packaging levels should be considered. There are three packaging levels, namely primary packaging, secondary packaging, and tertiary

packaging (Pålsson, 2012), which are illustrated in *Figure 1.1*. Primary packaging is one of the three distinctive packaging levels. This type of packaging is the layer of packaging that is in immediate contact with the product, also known as the first packaging layer in which the product is contained (Weirich, n.d.).

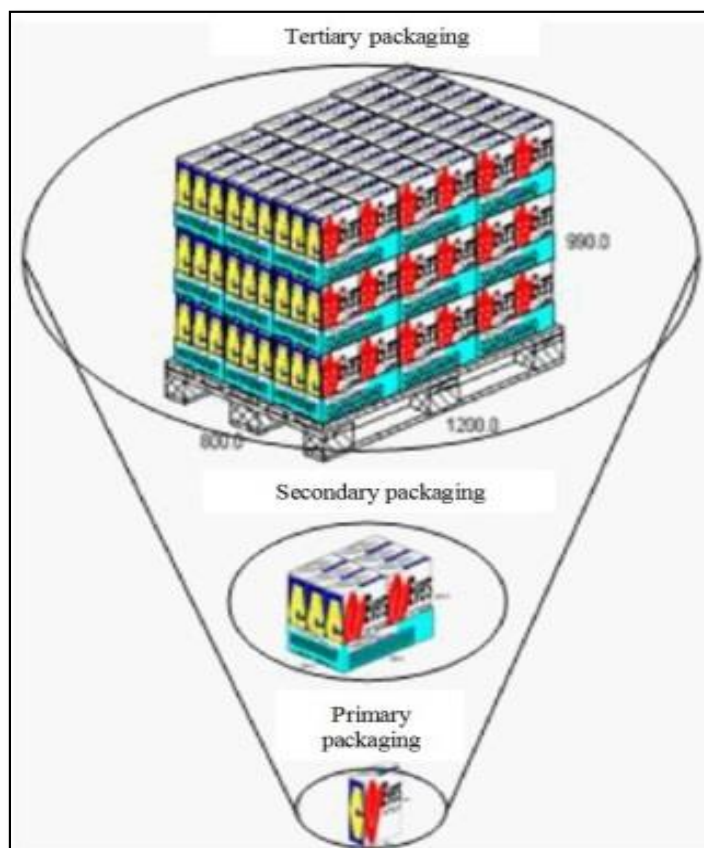


Figure 1.1: The six packaging levels known as primary, secondary and tertiary.
Source: (Pålsson, 2012)

The packaging considered in this research is a container that must comply with the specifications of carrying or storing fruit juice while keeping it fresh. One design that fits these criteria is the 1-litre aseptic carton at a primary packaging level. A design of a package can consist of the use of a single material or a combination of materials. These materials can include wood, paper, glass, plastic, and metal combined with specific production printing techniques.

Every material that is used in a package has unique properties (Hanlon *et al.*, 1998; Bramklev, 2007). These materials can be combined to create unique properties that will support any specific product in whatever state of matter it may be. It is used mainly for the fruit juice packaging and it is composed of paperboard with various coextruded layers or foiled laminated inners (Narciso & Parish, 1997). The aseptic cartons are designed to protect

the fruit juice and nutrients from light, oxygen, and micro-organisms to ensure a long shelf life (Tetra Pak, 2013). Paulapuro (2000) explains that the board is a multi-ply paperboard that is rigid and has strong wet sizing and a high barrier coating. The paperboard barrier must hold the liquid and prevent movement of air and fruit juice content from moving through it (Paulapuro, 2000). This type of packaging does not need to be chilled, since it contains products that have been processed by high temperature, such as milk or fruit juices (Sohrabpour *et al.*, 2012; Volmink, 2013). Savolainen (1998) explains that it is common to use aluminium foil together with polyethylene as barrier coating for products with a long shelf life. The backside of the board is the printing side and might have an extra ply that is suitable for printing (Savolainen, 1998).

Even though this form of packaging for fruit juices is the most common packaging used in South Africa and other parts of the world (Björck, 2013), there are some attributes that can be improved in order to use this package in the most efficient way possible (Volmink, 2013). The commonly known 1-litre aseptic carton is environmentally friendly as it enables long-term storage without refrigeration (Liqui Fruit, 2012).

As product manufacturers outsource their packaging needs to package manufacturers, the packaging manufacturers provide the packaging that is requested and not the packaging that is required (Olander-Roese & Nilsson, 2009). It can be further argued that the packaging manufacturers provide the packaging designs that are not necessarily always the best option for the relevant market and/or product (Björck, 2013; Volmink, 2013).

The drive for this research therefore started with an interest in the packaging logistics field and the need to identify a packaging design used in the South African market which can be changed. A change in packaging design may increase overall customer satisfaction and improve some supply chain functions directly linked with the design of the primary packaging (Bramklev, 2009; Collins II, 2015; Hellström & Nilsson, 2011; Pålsson, 2012). Some of these functions will be discussed later in this research. Customer satisfaction can generate repeat sales and brand loyalty (Collins II, 2015; Volmink, 2013) and improved supply chain functions may decrease costs and increase the productiveness of packaging production (ten Klooster, 2002).

1.2. Preliminary Research Design

This research was conducted in two phases. The first phase was an exploratory phase with the goal of identifying the validity of the research problem. The second phase was aimed at answering the research questions using different designs and methods, which will be discussed in detail in the Research Design and Methodology chapter.

Before any claims can be made, an exploratory data analysis (through an online survey) and interviews, that were conducted in order to support the validity of this research, should be considered. An exploratory study can be used as a trial study to estimate the viability of conducting and/or continuing with a larger study (DeForge, 2010). The two above-mentioned research methods assisted with guidance towards reaching the goal of this research, narrowing down the research problem, and identifying any indications leading towards the research objectives.

Each section will be initialised by making use of the Kipling approach. This approach utilises questions built around the following words: “What?”, “Why?”, “When?”, “How?”, “Where” and “Who?” (Trafford & Lesham, 2008). It is a great tool to use in identifying the research design and the relevant methods required to obtain the data that ultimately narrow down and define the problem of the study (Creating Minds, n.d.; Trafford & Lesham, 2008). The following open-ended questions listed from A to F help to shape the research design, which involves a series of linked decisions (Trafford & Lesham, 2008):

- A. *What* is it you want to discover?
- B. *Why* do you want to investigate it?
- C. *When* is the investigation to be conducted and over what period?
- D. *How* do you intend to investigate the topic?
- E. *Where* is the topic located and where is it to be investigated?
- F. *Who* are the respondents from whom data are to be collected?

Each of the proposed phases of this research can be analysed using the Kipling approach. Phase one (research problem) and phase two (research question one and two) is depicted in Table 1.1. It will ultimately assist in identifying the research design and methods required for either the research problem or the research questions.

Table 1.1: The six questions and answers derived from the Kipling approach for each phase of this research.

<i>Phase 1: Research Problem</i>	
<i>what</i>	Support problem statement for this research.
<i>why</i>	Support any claims made in problem statement and provide indications if research is valid to continue.
<i>when</i>	Beginning of the research.
<i>how</i>	Interviews, literature review, and questionnaire.
<i>where</i>	South Africa and Sweden.
<i>who</i>	Consumers, product manufacturers, and academics/scholars.
<i>Phase 2: Research Question 1</i>	
<i>what</i>	Identify the criteria on which the packaging scores poorly in terms of packaging performance.
<i>why</i>	Identify weaknesses of the packaging.
<i>when</i>	Closer to the end of the research.
<i>how</i>	Questionnaire in form of a packaging scorecard.
<i>where</i>	South Africa, Western Cape, Cape Town.
<i>who</i>	Product Manufacturers, Retailers, and Consumers/End users.
<i>Phase 2: Research Question 2</i>	
<i>what</i>	Research different product/packaging design and development processes.
<i>why</i>	Identify a relevant development process for the packaging relevant to this research.
<i>when</i>	Middle of the research.
<i>how</i>	Secondary data analysis
<i>where</i>	South Africa and Sweden.
<i>who</i>	Literature and experts in the field.

Source: (Trafford & Lesham, 2008)

1.3. Research Problem Statement

The success of innovative new packaging integrated with a product is based on the perception of the consumer (Bramklev, 2007; Collins II, 2015; Pålsson, 2012; Sohrabpour, 2012). Robert Collins II suggests that “Successful development of packaging will generate first purchase interest and deliver the product to the consumer intact and ready for use” (2015). The importance of customer satisfaction is clearly stated and if not implemented, it may have devastating effects on business (Volmink, 2013). However, not all companies get it right (Björck, 2013). The following sources provide key arguments towards the problems identified with the packaging designs:

Source A (Wasted product content due to bad design, 2014): From a video published on social media, the original poster was unsatisfied with the amount of product that remained

inside the fruit juice carton. The author of the video claims that this might be because of a bad spout design. The spout protrudes too deep into the carton resulting in some of the content being left inside the packaging. The packaging manufacturer replied to the video claiming that the problem will be forwarded to the research and development department.

Source B (Personal observation): The above-mentioned video inspired the researcher to do a personal investigation into the alleged problem. The investigation resulted in another problem being identified at many different retailers in South Africa. Before consumers even handle the packaging, some of the cartons were already crumpling on the top (see pictures in *Appendix A: Damaged and crumpled tops of 1-litre cartons*). The aseptic carton needs support from the secondary packaging because it is sensitive to impact and is not able to have a pressure load pushing down on it (Sohrabpour *et al.*, 2012). Consumers make a judgement about the product based on the condition of the packaging (Scheuneman & Tolette, 2010). If the packaging fails to deliver the desired “image”, it may cause the product to lose its public appearance and lose its perceived value to the consumers since the primary packaging design is not attractive anymore (Volmink, 2013; Olander-Roese & Nilsson, 2009). It may also displease the end user resulting in loss of sales (Klevås, 2013). The damage to the primary packaging may be caused during the stacking and/or transport phase (Sohrabpour *et al.*, 2012). It has been observed before with the aseptic cartons in the milk industry, where two reasons were identified that may cause this problem: the spout design can stick out too much and/or the incorrect secondary packaging is being used, which does not protect the primary packaging (Sohrabpour *et al.*, 2012). It is, however, argued that it is possible to consider changing the design of the secondary packaging and not the primary packaging (Sohrabpour, 2013). Since the secondary packaging and the primary packaging discussed in this research are designed and manufactured by the same company, the secondary packaging is sometimes designed specifically to fit the end-of-the-line machines in order to fold and erect it (Volmink, 2013). The latter reveals the need for integration between primary and secondary packaging. The primary packaging, mostly, cannot survive without the secondary packaging, and secondary packaging will only exist if primary packaging is present (Björck, 2013). Therefore, the state-of-the-art primary packaging designs that should be developed play a very important role (Björck, 2013; Pålsson, 2012; Volmink, 2013). From a logistics perspective, the integration of the two packaging systems can work together to improve the overall packaging system. This is supported by Jahre and Hatteland (2004) who explain that

the primary packaging should be the main focus and that the product itself is of secondary concern.

Source C (Online Questionnaire and interview): In order to prove the relevancy of this research, an online questionnaire using a convenience sample was used. There were eight questions in total that were based on the performance of two similar packaging designs using two different spout designs. Both these designs are used in South Africa. The online questionnaires were sent to consumers since consumers are ultimately the ones that come in direct contact with the fruit juice packaging. The sample size (N = 43) was a convenience target audience. The reason for choosing a convenience sample will be discussed in section 2.5 of Chapter 4. The results from the questionnaire can be seen in *Appendix B: Online Questionnaire Results*. The results revealed that the majority of respondents agreed that the spout designs cause a mess, splash, or spill when the content is poured (question two and six). More than half of the respondents did not find the two designs satisfactory (question one and four). The majority of respondents indicated that they struggle to break the seal of the spout (question three). More than half of the respondents indicated that they feel they waste some of the product when disposing the carton (question five). The majority said that they do not consume the product directly from the carton. Finally, 41.86% of respondents would prefer a different design to the two designs used in the questionnaire.

In summary, the results from the online questionnaires suggest that there are packaging design criteria or specifications that can be improved. It shows a need to identify criteria on which the packaging performs poorly and a way to implement the design and development for that criterion. This permitted that the research may be valid.

Furthermore, derived from the interviews, some experts in the packaging field claims that some designs can be improved and that even the packaging producers sometimes make mistakes regarding the designs and there are always room for improvements (Volmink, 2013; Björck, 2013). Some product manufacturers make use of the same carton design, but a different spout design. Because of this, it is important to differentiate your product from the competitors by making use of a unique graphical design or visual features. However, if possible, most product manufacturers aim to introduce a new design that will be unique to your product (even if it is just a different spout design) (Volmink, 2013).

The three arguments above (from Sources A, B, and C) focus on the following terms: primary packaging, aseptic cartons, new packaging design, packaging development, packaging

efficiency, and product and packaging integration. In addition, the problems listed above indicate that there is a need to change the packaging design. This may create a gap in the efficiency and effectiveness of packaging and packaging design in the supply chain (Olander-Roese & Nilsson, 2009). The list mentioned above indicates a possible need towards new packaging design and development in order to improve the packaging efficiency.

According to Bramklev (2007), packaging design and development plays an important role in the packaging industry in developing the product with regard to certain aspects and areas in the market. One of these areas where packaging plays a central role is the marketing and sales of a product (Klevås *et al.*, 2012). It also plays a very important role in the efficiency of the packaging (Olander-Roese & Nilsson, 2009). This may apply to all the levels in the packaging system. A final packaging design should therefore be established through a development process and the phases and activities in the process should replicate the goal of the project (Bramklev, 2007).

This research then moved towards ways to solve packaging problems of the current packaging designs and the necessary steps to be able to change the packaging design or develop a new packaging design. While the above-mentioned may or may not enforce a major change, the packaging efficiency throughout the supply chain should be analysed. It is important to remember that a reconfigured primary packaging design will influence the whole supply chain right up to when the end user consumes it and disposes of the product. Furthermore, a change in the primary packaging may influence a change in the secondary and tertiary packaging design.

1.4. Research Questions

Thorough empirical research starts with a solid representation of relevant literature and then identifies a research gap and suggests a research question that will address the so-called research gap (Eisenhardt & Graebner, 2007). However, before the latter can be executed, the problem statement provided a primary question for this research:

Are there indications of possible needs for new packaging design and development in order to improve packaging efficiency?

This question aims to identify the process of reconfiguring the current 1-litre aseptic fruit juice carton. Hence, the main objectives of this study are to consider a detailed analysis of an

old, existing, or new packaging design for the fruit juice industry and finding the best packaging system to enhance the performance of the packaging. Therefore, two secondary questions can be devised in order to provide the information required to answer the primary question. The first research question is conceptualised as follows:

1. *By making use of a certain packaging evaluation model, which packaging criteria (that affect packaging efficiency) should be improved by analysing different aseptic carton designs in the South African market?*

Firstly, this research investigates whether the current packaging used in the market at the moment is satisfactory to consumers. The question above will be used to explore current packaging, alternative packaging, and/or new packaging that can be used in the fruit juice industry in South Africa. The focus will only be on 1-litre aseptic carton designs. Following this, certain tools and techniques will be used to compare these packages by making use of a packaging evaluation model. The different evaluation models will be discussed in Chapter 3 where the best one will be chosen. The evaluation model should identify the most important packaging criteria that can be altered or developed in order to improve packaging efficiency.

Seeing that the development of a packaging system may be required, the second research question can be discussed. First, it is important to note that “packaging should be considered a mediator for innovation and thus developed and designed in such a way during the packaging development and design process” (Olander-Roese & Nilsson, 2009:288). Therefore, in order to implement the changes to the identified criteria in the first question, certain steps should be followed. There are always processes or operational references to follow in making any changes in any industry (Bramklev, 2007). However, there are many design processes available because of the different needs required for that specific product (Bramklev & Hansen, 2007c). The second research question responds to this:

2. *Which theoretical packaging development process can be presented in order to develop the packaging in terms of the criteria identified in question one and is it possible for the process to be a generic development process?*

The purpose of this question is to explore whether existing packaging development processes can be used to implement the change required to attain a certain packaging design. The second half of the research question specifies that if the packaging development processes researched do not apply to the current packaging (for example the 1-litre aseptic carton), it

will be possible to create a development process, from quantitative literature data, that is either generic or package-specific and focuses on specific packaging criteria.

The development processes will be broken down into the contemporary information about which activities and tasks are included in the packaging development process, in what order they are performed, and when communication takes place. While all of this is considered, the focus of the development process should remain on the South African market. There are packaging development process differences when comparing a developed country with a developing country (Sohrabpour *et al.*, 2012). Hence, if a change to any packaging design is necessary, the new packaging system should be studied to determine whether it will be able to satisfy the improvements required or if the change could be acquired by making an upgrade to the existing packaging design in South Africa (Pålsson, 2012). In other words, to satisfy the supply chain needs in terms of packaging efficiency, it should be determined whether the existing packaging design can be improved by only giving it a facelift or whether a whole new model is required. All of this should be considered only if the environmental impact is the same or improved.

1.5. Relevance of the Research

The problems identified in this research concerns certain carton designs in the fruit juice market in South Africa. The identified problem refers to a gap in the packaging logistics field. This gap will most likely affect all the actors in the supply chain. These actors (in order of supply chain structure) are packaging manufacturers (the producer/manufacturer of the packaging or packaging material), product manufacturers (the producers/manufacturers of the fruit juices), retailers and consumers (the end user of the fruit juices, which means that they are the final actors in the supply chain and will consume the product). Each actor has a certain need that a packaging design should address. Certain packaging criteria will fulfil that need. The research should therefore identify these criteria and provide solutions to implement them in the design, which in turn satisfy the needs of the actors and which might close the gap noted in the problem statement.

It should ultimately identify whether packaging designers could redesign and/or improve packaging designs by following the steps suggested in this research. This study can accordingly be used as a guideline towards identifying the weaknesses of a packaging design and making the changes to that packaging design where necessary.

1.6. Research Aims

This research attempts to contribute to the packaging logistics field. Sourcing and purchasing, production, warehousing and handling, transport, marketing, and climate conditions place various needs on packaging (Olander-Roese & Nilsson, 2009). These needs should be fulfilled in order to decrease supply chain costs or improve performance by focusing on packaging, which can compensate for weak infrastructure throughout the supply chain (Sohrabpour *et al.*, 2012). Furthermore, this study aims to assist packaging designers (the developers and designers of new packaging methods/solutions) in improving packaging design by focusing on packaging criteria that needs improvement. If these packaging criteria can be identified, the research will further aim to identify a packaging development process that can make the improvements that the packaging designer desires.

By designing a new or unique packaging, the product may get a unique appearance which can be identified easily by the customers and can differentiate your product from the competition (Volmink, 2013). Reconfiguring a design should result in addressing the current problems and challenges that may occur after assessing the usability of the current fruit juice carton and ultimately contribute to the improvement of the packaging efficiency (Olander-Roese & Nilsson, 2009; Hellström & Saghir, 2007). Improved packaging provides efficiency in production, efficiency during transport, environmental benefits, safety features, efficiency during unloading of container, and, finally, optimisation in transportation, storage, and handling (Boös, 2013). All of the above can be seen as logistics efficiency which is affected by improved packaging.

In terms of primary packaging for fruit juice, changes can be made to the graphic design, spout design, shape, size, material, and filling process (Volmink, 2013). In terms of the spout design, the aim will be to reduce the spillage of the content, enable faster pouring, and reduce content (fruit juice) remains, or waste, in the primary packaging. As mentioned in the problem statement in Source A, a certain spout design already in use on the aseptic cartons may be the cause of product waste. It is worse for the environment when consumers waste products than it would be to have extra packaging (Pålsson, 2012). Packaging's role is therefore to actually prevent waste. Furthermore, a different spout design may also reduce the space between the cartons when stacked on top of each other. This may increase the number of cartons that can be stacked in/on the secondary and tertiary packaging, thus improving the space utilisation of the packaging system.

In a case study by Olander-Roese & Nilsson (2009), a new packaging design improved handling in distribution centers and reduced the environmental impact of both transportation and handling. In terms of secondary packaging, changes can be made to improve the space utilisation, RFID tagging, and product protection. In terms of tertiary packaging, changes can be made to the weight limits in order to improve the handleability. Just by taking a step back and analysing the effects of change, more improvements can be seen on the primary packaging when compared to secondary and tertiary packaging. Seeing that the primary packaging comes in direct contact with the consumer (Pålsson, 2012) and that there are many competitors using the same primary packaging design (Volmink, 2013), the product that is being sold is directly marketed through the primary packaging (Sonneveld *et al.*, 2005; Bramklev, 2007), it makes sense to introduce design changes/improvements to primary packaging.

Seeing that the research focuses solely on the packaging of consumer goods, the focus will be on the manufacturing, distribution, and use of the packaging system. This falls under the product development of the industrial innovation process (Browning *et al.*, 2006). The context of this study is demarcated by the fruit juice industry and the South African market.

1.7. Research Objectives

The problem statement identified that there are some issues with the current packaging designs used in the fruit juice market of South Africa. To be able to identify these problems and provide theoretical solutions, two secondary questions were identified. Research question one aims to identify the problems of the current packaging designs through the use of packaging analysis tools. One of these tools could assist in finding the necessary criteria linked to the relevant packaging designs that can be improved or determine whether a new packaging should be developed using a packaging development process. An analytical decision should be made between designing a new packaging solution for the beverage industry and reconfiguring the existing design needs. The new or configured packaging design should ultimately assert the relevant criteria to which it should adhere in order to improve packaging efficiency in the beverage industry. Furthermore, research question two aims to investigate the different packaging development processes in the packaging field. In addition, it attempts to establish whether there is a specific packaging development process for the packaging type in question or whether a generic packaging development process can

be used. While the latter may or may not induce a major change to the packaging design, the packaging efficiency throughout the supply chain should be considered and analysed using the relevant tools mentioned earlier in this paragraph.

Improved or redesigned primary packaging may reduce cost, increase turnover, reduce damage complaints, reduce waste, change the ease of use for consumers, and change space utilisation of the primary packaging (Paine, 1991). In this case, a new packaging design might be required to enhance the customer experience, increase the fill rate, improve space utilisation, reduce related supply chain costs, reduce the carbon footprint, and decrease obsolesces that may occur, while adding value to the end user and improving packaging efficiency (Olander-Roese & Nilsson, 2009; Sohrabpour, 2013).

1.8. Scope and Limitations

The main factor that affected the quality of this research was the willingness of the relevant participants to share the required information. Some of the information required is sensitive and it may influence the participating companies negatively. One of the strategies used to overcome these challenges was to employ a confidentiality agreement which stated that no sensitive information would be shared that may influence the participant negatively or expose them to their competitors. Furthermore, consent was required from participants who agreed to partake in the packaging evaluation. The consent was given in the form of a signed document. The consent is necessary in order to make use of the data provided by the participants.

The term “sustainability” in the title only refers to the environmental impact of the packaging design or the packaging system. Although there are three main factors that comprise of sustainability (social, economic and environmental), the main focus will solely be on the environmental factor (i.e. the environmental impact a new or improved packaging may have when compared to previous designs if applicable).

The scope of this research consists of one packaging manufacturer, one product manufacturer, and four retailers. The reason for choosing the one specific packaging manufacturer is because the said company is one of the biggest suppliers of aseptic cartons, not only in South Africa, but the world (Tetra Pak, 2013; Volmink, 2013).

Furthermore, the time used to complete this research may result in a knowledge gap. This means that the rate at which things adapt and change may cause the development processes that are researched to become outdated before this research is concluded. Newer versions or new literature may appear without the author knowing or realising it. To avoid this, the author attempted to keep up to date with recent developments in the field.

Another limitation identified is the geographical area in which the data was gathered. More than 90% of the data gathered for the online questionnaire came from the Western Cape region in South Africa. This may be the same case with the data that was gathered for the packaging evaluation model.

Finally, the market environment in Europe is different than in South Africa or developing countries. The mindsets, when it comes to damaged packaging, are different. For example, consumers in Sweden will not buy a product if the packaging is damaged whereas in third-world countries, the chance of consumers not buying a product because of damaged packaging is less (Klevås, 2013). This might prove the research to be invalid in the geographical location it is done. However, it is argued that South Africa has a competitive market in packaging and any developments that may improve sales or the customer's perspective are always necessary (Volmink, 2013).

1.9. Brief Chapter Overview

This research has a total of seven chapters. A list of the chapters and a brief overview of their content follows below:

Chapter 1: Introduction

This chapter explains the background of this research and explains the problems that have been identified. This is followed by the research questions, aims, and objectives.

Chapter 2: Literature Review

This chapter is divided into four sections: section one examines the packaging integration with product development, logistics, and the supply chain; section two examines packaging efficiency through packaging evaluation models and chooses the best model to be used in this research; section three examines sustainable packaging; and the final section offers deductions made from the literature review.

Chapter 3: Key Literature for Secondary Data Analysis

This chapter discusses the key literature that can be used for the secondary data analysis. The literature focuses on packaging design and development. The secondary data adheres to content analysis coding, which will be conducted in the results and discussions chapter.

Chapter 4: Research Design and Methodology

In this chapter the structure and flow of the research are explained. The reason for some choices as well as the justification of how they were reached is explored. In addition, how and why this research was executed is explained.

Chapter 5: Results and Discussions

The results and discussions are grouped together. This simplifies the process of cross-referencing to relevant tables and figures. The results from a packaging evaluation model and results from the secondary data analysis are discussed in this chapter.

Chapter 6: Summary and Final Conclusions

In Chapter 6, a brief explanation of the goals reached for each chapter is provided. The title, primary question, and research questions are summarised. This is done by using the information gathered and results obtained from the literature, the results, and the discussions to form a complete discussion of the research process.

Chapter 7: Recommendations for Future Research

The last chapter lists some recommendations when doing research in the packaging evaluation and packaging design and development fields in the future. It also explains the challenges obtained during the research process and the conclusions drawn from the results obtained.

Chapter 2: Literature Review

The theoretical information underlying this study stems from a consideration of the literature below. The important theoretical concepts (indicated in bold) can already be seen in the formation of the study's title:

Identifying packaging criteria for sustainable packaging design and development: Towards packaging efficiency and packaging integration in the fruit juice industry of South Africa.

The theory regarding concepts and basic terminology behind *identifying packaging criteria* to improve *packaging efficiency* (i.e. to identify packaging development needs), *packaging integrations* (i.e. to ensure packaging is integrated with the whole supply chain resulting in positive outcomes), and *sustainable packaging*, with the focus in the environmental impact and which can be applied through packaging development, are discussed in this chapter. The goal was to gain background knowledge of packaging terminology and concepts. Section one discusses the packaging integration with product development, logistics, and the supply chain. Section two discusses the packaging evaluation models that can be used to identify the packaging criteria on which a packaging design performs poorly. Section three briefly explains the importance of sustainable packaging when considering packaging development. Section four discusses the conclusions drawn from the literature review.

2.1. Packaging Integration with Product Development, Logistics, and the Supply Chain

Analysts claim that 80% of supply chain cost is predetermined in the design of the product and supply chain network (Spinnaker, 2013). With increased efficiency and effectiveness, more value is added than costs (Sohrabpour *et al.*, 2012). More value attached to the product means the consumers are satisfied with the product (Volmink, 2013); Bramklev, 2007; Collins II, 2015), all because the product and packaging can be developed and improved to work as an integrated system (Olander-Roese & Nilsson, 2009; Bramklev, 2007; Collins II, 2015). However, despite these aforementioned theoretical perspectives, Bramklev (2007b, cited in Olander-Roese & Nilsson, 2009) and other researchers (Saghir, 2004; Olander-Roese, 2008) claim that little evidence of integration and internal collaboration exists in the

development of packaging solutions. *Figure 2.1* depicts the perfect integration in the supply chain between the product, packaging, and logistics.

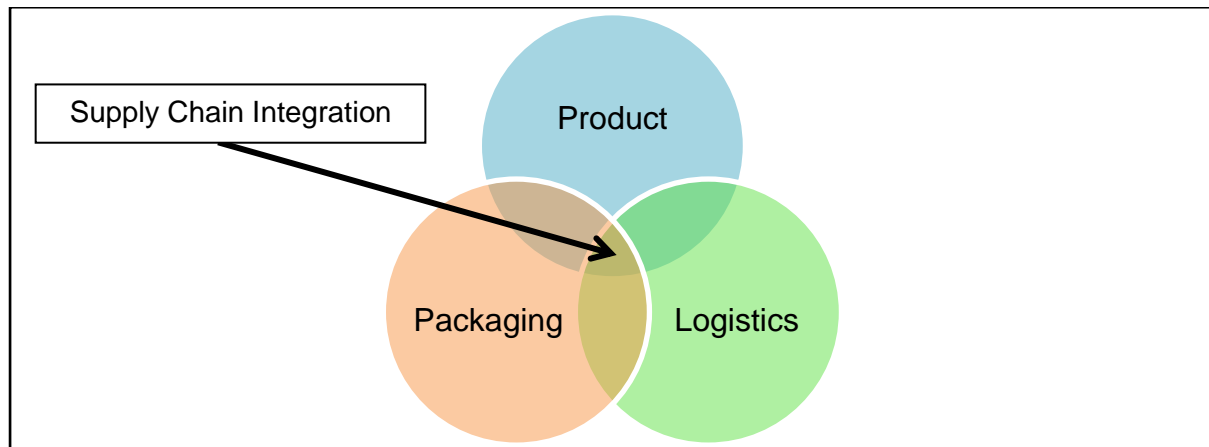


Figure 2.1: Integration in the supply chain between the product, packaging, and logistics.

Source: (Bramklev, 2007b)

The lack of consideration to view packaging as a whole throughout the supply chain may often lead to big amounts of waste (Sohrabpour *et al.*, 2012; McGuire, 2001). Such waste can be a result of various reasons, which include packaging deterioration and spoilage (Taylor & Pettit, 2009). Sohrabpour *et al.* (2012:200) accordingly state the following: “It is therefore important to have a holistic packaging perspective in order to develop and design effective packaging systems for supply chains.”

2.1.1. Packaging Integration with the Product Development

Innovations in packaging and packaging systems are connected with the success of the contained products in the market (Magnusson *et al.*, 2012). According to an empirical study from Bramklev (2007) based on a concept from Bjarnemo *et al.* (2000), there are strong interests in and needs to implement and develop an integrated procedure model for the industry. Assessing a packaging design is much more complex than assessing the product groups since the environmental impact is “doubled” (directly and indirectly) through system enlargement by combining the packaging and product system (Svanes *et al.*, 2010).

The concept specifically focuses on the integration of packaging logistics into the product development process. Furthermore, Bramklev and Hansen (2007c, cited in Olander-Roese & Nilsson, 2009) and Saghir (2004) claim that there is an absence of integrated packaging design and development in terms of logistics and supply chain systems. Furthermore,

Olander-Roese and Nilsson (2009), citing Rundh (2005), Hellström and Saghir (2003), Beckeman (2006), Bramklev (2007b), and Twede (1992), claims that it is better to integrate packaging in the earlier stages of new product development. The reason is to avoid packages being developed which does not collaborate with the product in the supply chain. Furthermore, according to the above mentioned references, it is beneficial to see packaging as a driving force of innovation. However, even where product manufacturers have their own internal function to develop packaging, there are still signs that product and packaging design is not an integrated system in terms of logistics and the supply chain (Bramklev, 2007b). This can be seen in *Figure 2.2* where product and packaging development are treated as separate entities.

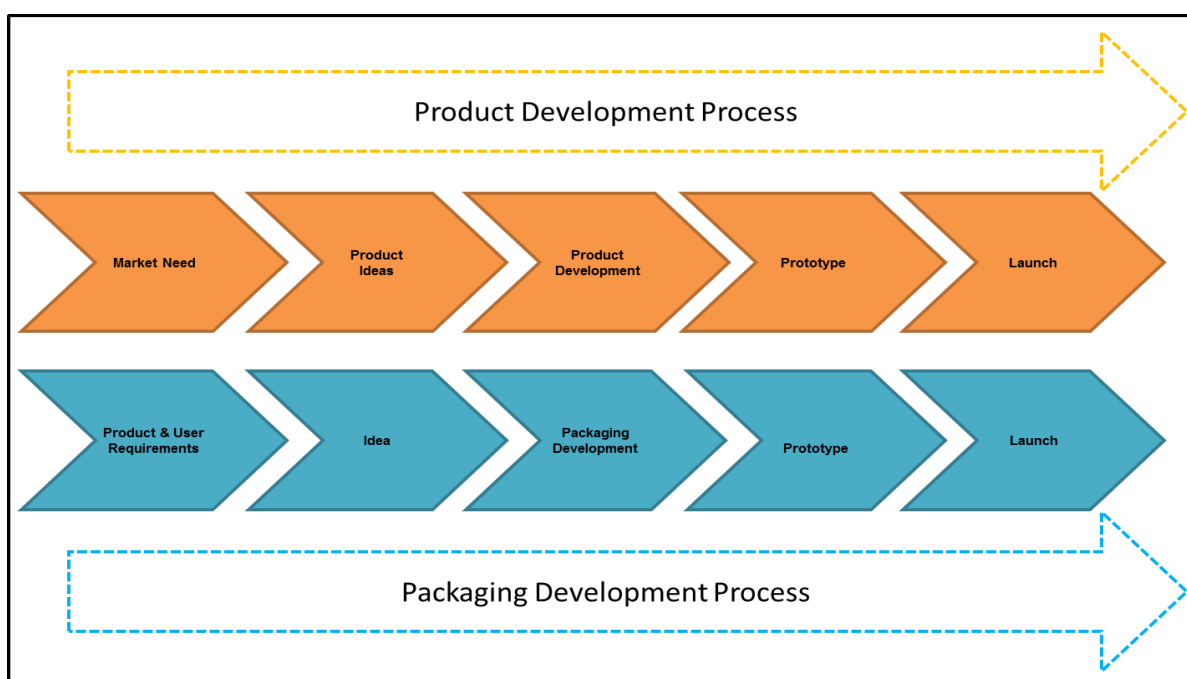


Figure 2.2: Product and packaging development process seen as two different processes.
Source: (Bramklev, 2007)

The packaging development “cannot be seen as a secondary developmental effort in developing a product” (Collins II, 2015). Because the product is dependent on the packaging design, there are strong interests in and needs to implement and develop an integrated procedure model for the packaging industry (Bramklev, 2007).

Olander-Roese and Nilsson (2009) citing Lamming *et al.* (2000), Gulati *et al.* (2000), and Pfohl and Buse (2000) claim that the competitive advantage in business has moved from company versus company to supply chain versus supply chain. The key advantage lies in

innovation of packaging in the fast moving consumer goods industry and not only in cutting the cost of the efficiency (Olander-Roese & Nilsson, 2009).

Packaging is also considered an important element and may have a huge impact on logistics costs and performance (Twede, 1992). In terms of logistics, the packaging must be handled and the product itself is of secondary concern (Jahre & Hatteland, 2004). However, this may cause a problem when the product is handled, since it may cause spillage or damage to the contents inside the primary packaging (Sohrabpour *et al.*, 2012). Therefore, the need for integration between product and packaging is yet again highlighted. This integration is depicted in *Figure 2.3*, where the product and packaging design and development processes should be combined early on in their respective operations.

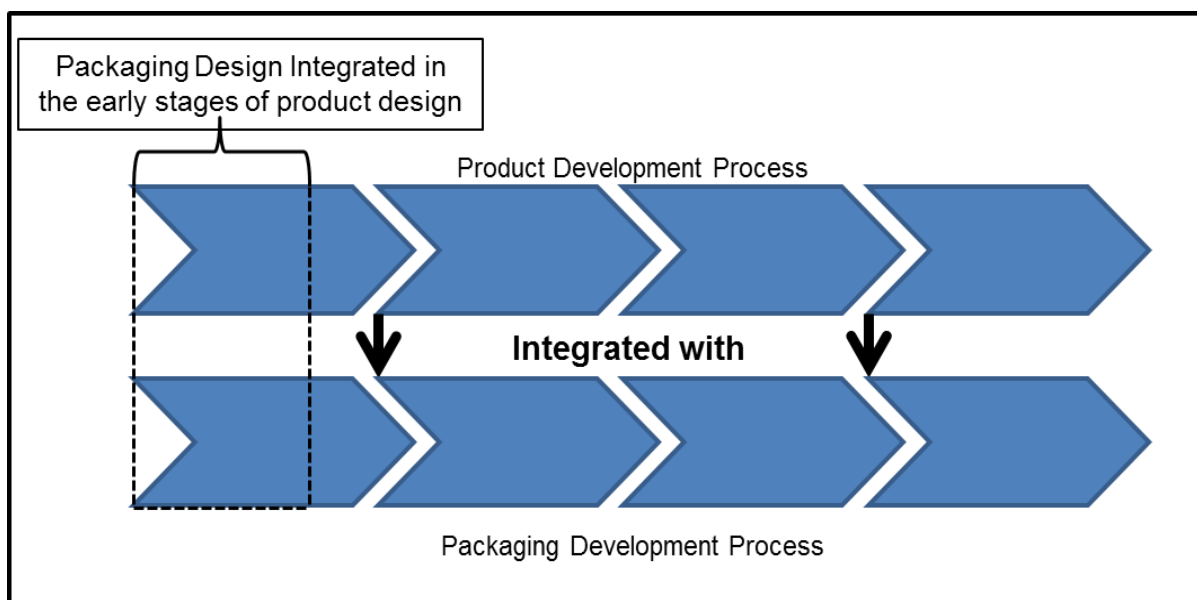


Figure 2.3: Product and packaging development processes integrated early on in their respective operations.

Sources: (Bramklev, 2007; Klevås *et al.*, 2012; Olander-Roese & Nilsson, 2009)

Integration of these processes is therefore an important requirement/factor to consider when developing a new product or packaging for the product (Bramklev, 2007; Collins II, 2015; Sohrabpour, 2012). If it can be integrated early on in the stages, it will benefit the efficiency of the supply chain in terms of packaging (Bramklev, 2007b).

2.1.2. Packaging Integration with Logistics

Logistics is the art and science of managing and controlling goods that involve the integration of information, transportation, inventory, warehousing, material handling, and packaging (Bramklev & Hansen, 2007c). Packaging has an impact on the efficiency of logistics

activities such as transportation, storage and handling, and the logistics system as a whole (Bramklev & Hansen, 2007c). Therefore, research related to logistics should focus on the integration of packaging design and logistical activities (Hellström & Saghir, 2007) and the packaging decisions that are made should be made in accordance with the logistics planning perspective (Lockamy III, 1995).

A package would have to adapt to the different needs of logistics (Jahre & Hatteland, 2004). However, in the logistics environment, packaging development should focus on packaging-related logistics activities (Hellström & Saghir, 2007). Therefore, Hellström and Saghir (2007) state that there are three areas where packaging-related improvements in the supply chain can be made: in the logistics process, in the packaging system, and in interactions between the two. The third part creates the interface between different packaging levels and various logistics processes along supply chains (Hellström & Saghir, 2007), i.e. the integration of packaging and logistics in the supply chain. However, Stock (2001) found that packaging has a minor impact on logistics from a research point of view (Sohrabpour *et al.*, 2012). It is further argued by some researchers that this may be the cause of a general view that packaging has limited influence on the performance of the supply chain (Hellström & Saghir, 2007). Sohrabpour *et al.* (2012), however, state that literature found in the fields of packaging, logistics, supply chain management, and humanitarian aid does not cover how packaging interacts with the supply chains in developing countries. Because of all these reasons, different methods, models, tools, and procedures have been developed to change the aforementioned perception (Sohrabpour *et al.*, 2012). Some of these evaluation tools will be able to evaluate the performance of the relevant packaging used in this research and will be discussed further in the next section of this chapter.

It can also be observed that the product and packaging form an integrated system, namely a product-package system (PPS). PPS forms part of the globalisation of today's global companies (Bramklev, 2007). These companies operate in a network of functions and divisions like product development and production. This kind of network is spread worldwide. The globalisation increased the demands placed on logistical issues, especially packaging and transporting final products (Bramklev, 2007).

Integration, therefore, of the packaging design and development process should favour the effects on logistics efficiency. Logistics efficiency consists of activities such as transportation, storage and handling, and the logistics system as a whole (Bramklev &

Hansen, 2007c). Packaging collates with the above-mentioned activities and therefore any changes to packaging or packaging design will affect the logistics efficiency (Olander-Roese & Nilsson, 2009). According to Stock (2001), the following factors were rated as important when logistics within supply chains were considered: product quality, competitive prices, consistent order cycle times, on-time deliveries, and low damage rates. These factors have been very important, and will continue to be so in the future (Stock, 2001).

2.1.3. Packaging Integration with the whole Supply Chain

Every single carton that is designed by the packaging manufacturer and presented to the product manufacturers should fit the end-of-the-line efficiency that the customers are looking for (Volmink, 2013). As mentioned in the problem statement, the absence to view packaging as a whole throughout the supply chain may often lead to big amounts of waste (Sohrabpour *et al.*, 2012; McGuire, 2001). Furthermore, integration contributes to rapid market response, fulfilment of customer needs, and cost efficiency (Pållson, 2013). It is therefore important to have a holistic (or centralised) packaging perspective in order to develop and design effective packaging systems for supply chains (Sohrabpour *et al.*, 2012). The approach towards packaging should be holistic instead of compartmentalised, which can be seen in *Table 2.1*. A holistic packaging approach includes evaluating the supply chain requirements for packaging and packaging demands on supply chains as an interdependent, continuous and dynamic system (Hellström & Nilsson, 2011). A holistic approach will include and cater for the packaging needs throughout the supply chain and will do so in an efficient way.

Table 2.1: Interactions between packaging systems and logistical processes.

Logistics process		Product Manufacturer		Retailer			Consumer			
		Filling process	Storage	Transport	Receiving process	Storage	Shelving	Picking	Transport	Recyclable
Packaging Levels	Primary	X	X	X	X	X	X	X	X	X
	Secondary	X	X	X	X	X				X
	Tertiary		X	X	X					

Source: (Hellström & Nilsson, 2011)

The interactions between the packaging system and the logistics processes consist of:

- The primary and secondary packaging interact during the filling process at the manufacturer, whereafter only the secondary packaging comes into contact when handled during transportation and when received by the customer/retailer.
- The retailers also interact with the primary packaging as they have to unpack it from its secondary packaging in order to display it on their shelves.
- The consumer only comes into contact with the primary packaging when buying the product at the retailer.

The product manufacturers should over time structure and vertically integrated the business strategy to form a supply chain to safeguard the company against any sudden or drastic changes in the marketplace (Botes *et al.*, 2012). Therefore, according to Bramklev (2007), the integration of a packaging development process should be done in a centralised organisation and not a decentralised organisation. The advantages and disadvantages of a centralised organisation and a decentralised organisation for packaging development are illustrated in *Table 2.2* and visually presented in *Figure 2.4*.

In a centralised organisation, decisions are integrated with the organisational functions. In a decentralised organisation, the decisions are made outside the functions of an organisation.

Table 2.2: Advantages and disadvantages of centralised and/or decentralised organisations.

Centralised		Decentralised	
Advantages	Disadvantages	Advantages	Disadvantages
High packaging competence	Long development lead times for product and packaging	Close connection to product development	Insufficient communication, coordination and control
High packaging authority			No obvious link to logistics
Connection to logistics			Loss of packaging competence & authority

Source: (Bramklev, 2007)

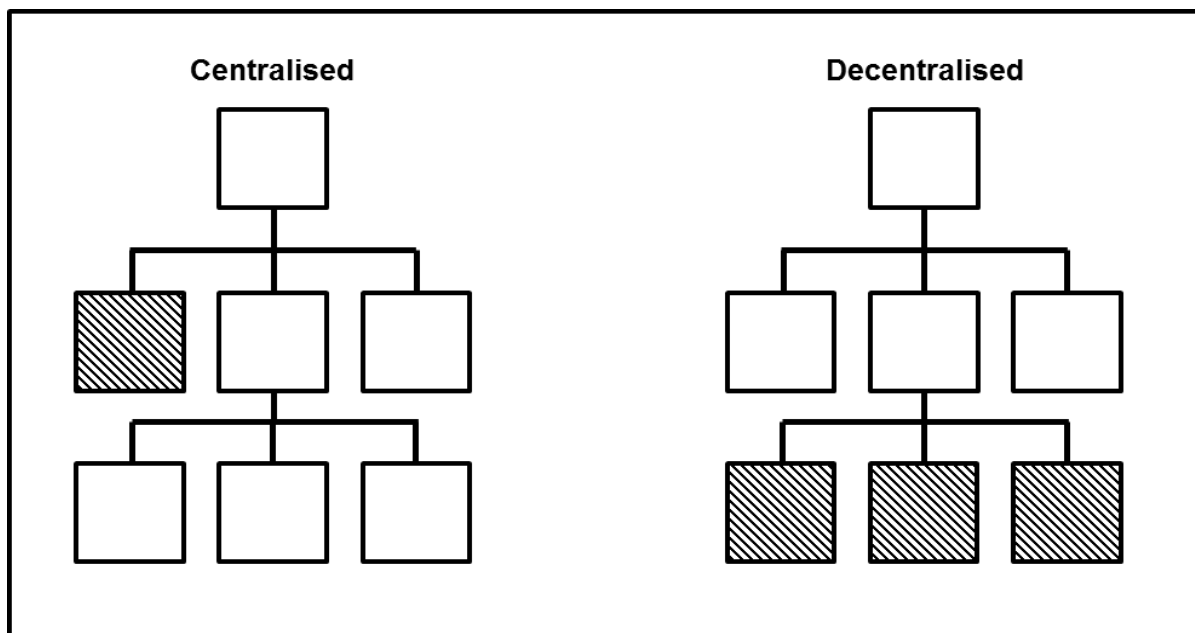


Figure 2.4: Structure of centralised and decentralised organisations.

Source: (Bramklev, 2007)

Olander-Roese & Nilsson (2009) claims that products are never handled on their own, but rather in a form of packaging. Hence, the product is dependent on the packaging design in mainly the primary packaging level (Bramklev, 2007). In terms of the packaging for the fruit juice, the packaging should protect the juice from the environment in which it is handled and it should provide a resealable opening in order for the content to be poured out of the packaging in a convenient way (Björck, 2013; Volmink, 2013). Even small design changes in the product and packaging can affect the efficiency and effectiveness in the logistical activities as well as the whole supply chain (Collins II, 2015; Olander-Roese & Nilsson, 2009). Packaging design should be a system approach and it is important to understand where the system boundaries are (Pållson, 2013).

Basically, if a change is made to a packaging design, it is important to understand what the effect will be down the line. For example, when considering PET bottles or aseptic cartons for beverage packaging, it should be noted that both are recyclable, but one is more expensive to reuse than the other one. Ultimately, both material options (PET and aseptic cartons) should be considered in terms of the impact they could have throughout the whole system. Therefore, if the 1-litre fruit juice carton should be reconfigured, it will have an effect on the fields (logistics, marketing, production, product development, and the environment). It is therefore important to keep in mind that any changes will affect these fields when a decision for a new packaging design is made. Furthermore, it will affect the whole supply chain – from the sourcing of the product packaging to the delivery to the retailer of the end product.

The challenge therefore is based on having a holistic view of the supply chain regarding packaging (Sohrabpour *et al.*, 2012).

As mentioned earlier, when a new packaging design is introduced, there may be some implications for the supply chain (Sohrabpour *et al.*, 2012). The performance of a packaging system is not recognised by the performance of a single component, but by the interactions between them (Hellström & Saghir, 2007). Furthermore, it will affect the different fields in which the packaging system interacts (Sohrabpour *et al.*, 2012). The interactions, as mentioned, occur between all the packaging levels (primary, secondary and tertiary) and the different fields, which are logistics, marketing, production, product development, and the environment (Sohrabpour *et al.*, 2012). All the actors in the supply chain will also be affected by the change. Reducing the risk in a major transformation will benefit not only the supplier and customer, but all the other role players in between. The four basic role players identified by Klevås *et al.* (2012) are the supplier, distribution centre, store (retailer), and the customer (consumer).

There is an increasing propensity for packaging to be part of an integrated system (Jahre & Hatteland, 2004). This means that packaging needs to be part of the whole supply chain involving different packaging levels or systems and additional logistic activities. Packaging interacts with almost all of the logistical activities and according to Jahre and Hatteland (2004) this affects vehicle investments and operational costs, production costs, material handling and inventory costs, and costs related to information processing and purchasing.

2.1.4. Summary of Section one

To conclude this section, the importance of packaging integration was explained carefully by considering product development, logistics, and the supply chain as a whole. This section highlighted the importance of integrating the three main features to gain perfect supply chain integration. This was visually presented in *Figure 2.1*. Furthermore, the title of this study suggests that packaging integration should be considered when designing or developing a new package or packaging system. Therefore, the packaging, product, and the logistics involved should be integrated early in the development stages of the product-packaging system (PPS) in order to gain a holistic perspective of the supply chain.

2.2. Obtaining Packaging Efficiency through Packaging Evaluation Models

There are principles in the packaging industry that should be met in order for it to be a viable packaging system (Klevås *et al.*, 2012). Two principles are identified by James *et al.* (2005), namely packaging effectiveness and packaging efficiency.

The efficiency principle is applied in the packaging system level and the effectiveness principle is applied at society level (James *et al.*, 2005). *Packaging effectiveness* includes enhancing customer experience and improving sales, communication, and branding to the consumers (Olander-Roese & Nilsson, 2009). Effectiveness adds real value to society effectively protecting and containing the relevant products as they move through the supply chain by supporting informed and responsible consumption (James *et al.*, 2005). In terms of *packaging efficiency*, packaging systems are designed to use materials and energy in the most efficient way possible throughout the whole product life cycle, including the interactions with related support systems, namely storage, transport, and handling (James *et al.*, 2005). Packaging efficiency includes ease of handling, logistics, traceability, and protection (Olander-Roese & Nilsson, 2009).

As mentioned before, packaging efficiency forms part of logistical functions and it indicates the integration of packaging and logistics and therefore is a good principle to use during product or packaging development process (Olander-Roese & Nilsson, 2009; James *et al.*, 2005). Furthermore, because of the increasing costs in logistics-related activities, advances in packaging technology and strict environmental legislation, packaging decisions should be an important aspect in strategic logistic planning (Lockamy III, 1995). The packaging industry uses procedures for an efficient and effective flow of the relevant business processes. By keeping to a process and maintaining the packaging development in a structured process form, the operational side of the projects can be measured and kept efficient (Bramklev, 2007).

In marketing, packaging logistics can be regarded as an important tool. It could be regarded as a 5th P in the marketing mix (Bramklev, 2007). From a marketing point of view, the package can be classified in four packaging types: (1) *industrial packaging*, to optimise logistics aspects; (2) *institutional packaging*, to improve institutional logistics aspects and enhancing consumer utility, (3) *consumer packaging*, to optimise consumer utility; and (4) *military packaging*, which is highly specialised protective packaging with emphasis on

inspection and product identification (Hanlon *et al.*, 1998). Of these four packaging types, consumer packaging may be considered as relevant to this research, because it is best represented by the packaging systems used in fruit juice packaging. The performance of the packaging system is not only affected by the performance of each packaging level, but also by the performance of the different packaging levels in the system (Hellström & Nilsson, 2011).

Packaging is designed to act as a barrier between the product and the activities that are executed on the product (Bramklev, 2007). These activities include handling, transportation, and consumption or use of the product. Most products are not able to endure all the parts of their life cycle, due to nature of its structure and components, and would therefore require packaging during parts of the life cycle. This means that the packaging should be designed to contain, protect/preserve, inform/sell, and enhance the convenience of the product (Bramklev, 2007).

According to Bramklev (2007), F.A. Pain (1991) was one of the first researchers to establish an overall function structure for packaging, which consisted of protecting and collecting the content as well as providing information about it. Currently, because of the influence of globalisation and logistics, the original function structure has developed into four main packaging functions: protect, contain, provide handling utility, and inform (Lambert *et al.*, 1998; ten Klooster, 2002). There are nine subfunctions listed in the EU Directive on Packaging and Packaging Waste (1994). Lockamy III (1995) identifies six functions (also called elements) and finally Olander-Roese and Nilsson (2009) claim that packaging is also considered a system that prepares the product for ten functions. All the above-mentioned functions or elements are depicted in *Table 2.3*.

When considering the element “be accepted by the consumer” identified by Paine (1991), it should be noted that part of this element can be influenced by the design of the primary packaging, since the primary packaging comes in direct contact with the end user (Pålsson, 2012). Therefore, changing the packaging design of the primary packaging is of importance, since it affects the end user directly. This view can be further supported with a survey done by Olander-Roese and Nilsson (2009). They (Olander-Roese & Nilsson, 2009) conducted the survey among twenty-four respondents in the Swedish supply chain and concluded that the packaging line efficiency of primary packaging was important for producers and the shelf stocking, sales, and promotional aspects were important for the retailer.

Table 2.3: Functions/elements of packaging.

Packaging Functions		
Paine (1991)	Lockamy III (1995)	Olander-Roese & Nilsson (2009)
Protect the product	Containment	Safe, efficient and effective handling
Adapt to package production process	Protection	Transport
Accommodate filling and packing	Apportionment	Distribution
Facilitate transport, handling etc.	Unitisation	Storage
Contribute to product presentation and marketing	Communication	Retailing
Accepted by consumer	Convenience	Consumption and recovery
Provide necessary information		Reuse or disposal
Fulfil given safety demands		Maximise consumer value
Adapt to the demands established by legislation		Sales
		Profit

Sources: (Paine, 1991; Lockamy III, 1995; Olander-Roese & Nilsson, 2009)

Seeing that the functions of packaging are identified, requirements should now be considered at the different packaging levels. The requirements of primary packaging are important to consider when the most desirable primary packaging concept should be manufactured (Olsmats & Dominic, 2003). Some of these requirements include user requirements, production requirements, supply chain requirements, product requirements, market requirements, and environmental requirements (Pålsson, 2012). Furthermore, packaging decisions regarding containment and protection directly affect packaging design, packaging materials to be used, handling, transportation, pollution, recycling, and spoilage costs (Lockamy III, 1995).

With the increasing need for a holistic approach of packaging and more complex supply chains, methods or tools to evaluate the contribution of packaging towards the efficiency and value creation in the supply chain are required (Olsmats & Dominic, 2003). There are several methods to analyse the current packaging system or compare a new packaging system to an existing one. Whatever the case, these methods can analyse and/or apprehend the strengths and weaknesses of the package system proposed in this research. Hence, in order to identify these criteria for a specific packaging, evaluation models can be used (Lund University, 2009, s.v. 'Packaging Logistics').

The packaging evaluation models considered below are Life Cycle Analysis (LCA), Comparative Packaging Assessment (COMPASS), the Packaging Scorecard, and the PIQET. These evaluation models are discussed to reveal the best model to address the research question and acquire the data required to attain the research objective.

2.2.1. Life Cycle Analysis (LCA)

The LCA is a well-known instrument used to assess the environmental problems and impacts throughout the repeated and interlaced stages of a product system, from raw material acquisition or generation from natural resources, through production and use, to final disposal (International Journal of LCA, 2015). LCA is used to define and evaluate the total environmental impact of a product, process or activity (Pålsson *et al.*, 2011). Furthermore, the LCA will identify and quantify the energy and materials consumed and the amount of waste released into the environment (Pålsson *et al.*, 2011).

An LCA can be used to predict anticipated change to a specific system and is a good tool to incorporate when competitive actions are required (Day, 1981). It is a good environmental management tool that assesses the system (in this case the packaging system) from the beginning of the supply chain to the very end (Arena *et al.*, 2003). The benefits of the LCA is that it may simplify strategic planning, prepare the regulations, identify the hotspots, enable comparisons of options with a life cycle, identify the research priorities, compare products, facilitate education, provide information regarding environmental impact, and simplify eco-labelling (Pålsson *et al.*, 2011).

2.2.2. Comparative Packaging Assessment (COMPASS®)

The Comparative Packaging Assessment (COMPASS) is an online software tool for packaging designers and/or engineers to assess the ecological and social impact of different packaging designs (COMPASS – Comparative Packaging Assessment, 2015). It allows comparisons to be based on environmental metrics. Designs are accordingly compared to each other throughout their life cycles and packaging attributes. In addition, COMPASS can be seen as a packaging modelling tool that allows comparisons of packaging designs based on environmental metrics developed by the Sustainable Packaging Coalition (Selke & Aurus, 2013). Criteria such as “fossil fuel consumption, water consumption, greenhouse gas emissions and human and aquatic toxicity” are considered as part of COMPASS (COMPASS

– Comparative Packaging Assessment, 2015). COMPASS is therefore best used as a guiding tool and not to calculate definite answers.

2.2.3. Packaging Scorecard

The balanced scorecard (Kaplan & Norton, 1996) creates future value through investment in customers, suppliers, employees, processes, technology, and innovation. However, based on the need for a holistic approach to packaging, Dominic and Olsmats (2001) developed the packaging scorecard.

The packaging scorecard is a very good evaluation model to use in terms of effectiveness (to make the right decisions) and efficiency (to make decisions quickly). This type of evaluation method suits a “management style” well and can be beneficial when bigger managerial decisions need to be made (Cooper, *et al.*, 1999). The packaging scorecard is intended for measuring performance of a packaging system in the supply chain, make comparisons between different packaging systems, and identify which part of the packaging or the packaging system should be redesigned or altered (Pålsson, 2013). The main goal, however, is to satisfy the final customer needs (Olsmats & Dominic, 2003). This can be achieved by identifying the criteria on which the packaging performed poorly.

There are many packaging criteria that can be used with role players throughout the whole supply chain. However, this study only used the relevant packaging criteria identified by Dominic & Olsmats (2001). A researcher may add or remove packaging criteria depending on the desire of the outcome and the objectives of the analysis (Pålsson, 2013). The following packaging criteria may be relevant in the context of this research:

Machinability – Machinability is the ability of packaging materials to be processed effectively in the production line (Pålsson, 2013). A change in the primary packaging design can have an effect on the production line (Olander-Roese & Nilsson, 2009) since it influences the machines used in the filling process and/or production process (Bramklev, 2007).

Product Protection – A package is designed to be used as a barrier between the product and the activities, in which the product is stored, handled, transported, and used (Bramklev, 2007). In normal circumstances, the functions of the packaging are to protect, inform, sell, and enhance the convenient use of the product, which ultimately means that the packaging should work in conjunction with the product in order to protect it against the environment to

which it is not fully adapted (Bramklev, 2007). Therefore, the product and the package form an integrated system of two components called a Product-Package System (PPS) (Bramklev, 2007). The product should also be protected against a variety of climate conditions to which it may be exposed (Sohrabpour *et al.*, 2012).

Flow Information – The capability to inform in the supply chain (Pålsson, 2013). The packaging should show the correct information, which is related to logistics and can easily be tracked when needed.

Volume and Weight Efficiency – The ability to make use of the available volume and load capacity (Pålsson, 2013). If the volume and/or weight are/is not efficiently used, it can have a negative impact on the logistical control of the packaging, which may result in turn in obsolete products or damage to the product or packaging (Sohrabpour *et al.*, 2012)

Right Amount and Size – Once the pallet is loaded onto a truck, the customer can ensure that the trucks are loaded to its maximum capacity (stackability). This is obtained when the space between the packages are kept to a minimum (also known as “coefficient of fullness” in the packaging environment. The correct trucks are the trucks that can be stacked double (two pallets on top of each other) or trucks that can carry thirty-two pallets (Volmink, 2013). Ultimately, the better the coefficient of fullness and unnecessary weight are managed, the more cost-effective the transport of the cartons will be (Volmink, 2013).

Handleability – According to Sohrabpour *et al.* (2012), manual labour extends the lead time in the supply chain and contributes to higher overall costs. Furthermore, ensuring that the workers handling the packages have adequate training and comfortable workspace will reduce the risk of damages to the product packaging. The ergonomics in terms of size, weight, and shape is an important factor when considering the handleability of primary or secondary packaging. Furthermore, Sohrabpour *et al.* (2012) add that the suitability to fit the retail shelf, attractiveness to consumers, and the ease of being carried home are three main marketing factors to consider in terms of packaging (Sohrabpour *et al.*, 2012).

Product Information – A packaging design should not only adhere to the product manufacturer’s standards, but it should also comply with the labelling regulations. When the design is finished, the master artwork is sent to the printing company. Before the printing company prints the design, the design may change as a result of the printer’s format.

Therefore, it may need to be finalised by the packaging development manager to ensure that it looks the same as the master art.

Selling Capability – As mentioned under handleability, Sohrabpour *et al.* (2012) identified that attractiveness to consumers is an important factor in packaging, especially primary packaging since the primary packaging is the part of the packaging system that comes in direct contact with the end user (Bramklev, 2007). In terms of the packaging, an attractive design, graphical representation and neatness, and ease of use (handleability) are some of the most important aspects to improve when marketing the capability of the product (Sohrabpour, *et al.*, 2012).

Safety – The ability to protect the product from shoplifters (Pålsson, 2013).

Reduced Use of Resources – This entails a reduced load on the environment (Pålsson, 2013). Not only can the reduced use of resources be directly linked to the primary packaging, but it can also have an effect down the supply chain. It is not always possible to use 100% recyclable materials since it is not always strong enough to handle the external factors playing in on it (Towman, 2013; Tetra Pak, 2013). A good example of this is fast growing trees that have short fibres and is therefore not strong enough to sustain the impact to which it will be subjected (Towman, 2013).

Minimal Use of Hazardous Substances – The amount of hazardous substances in the packaging, which can be either hazardous for the consumer or the environment, are kept to a minimum.

Minimal Amount of Waste – According to Volmink (2013), the customer is liable for any breakages or obsoletes all the way through to the end user. The disadvantage is that the brand name gets bad publicity, although the packaging is from another company. Furthermore, the supplier sometimes does make mistakes regarding the packaging specifications and it is therefore the customer's responsibility to fix any problems.

Packaging Costs – These are the total costs of the packaging system, which include the assembly, production, and filling machines.

Stackability – The availability of storage space in the supply chain is the main reason for a need to the effective stacking capability of packages (Sohrabpour *et al.*, 2012). It is important to get maximum cube efficiency on all the pallets because the pallets are mostly stored at the

customer's premises (Volmink, 2013). Since the packaging need is present throughout the whole supply chain, the stackability requirements will also apply to the transportation of the product and the stacking on the stands at the retailers. In order to decrease transportation costs, supply chain actors should utilise all the space available in trucks and the warehouse (Sohrabpour *et al.*, 2012).

Spout Design – This packaging criterion was added in accordance of this study's needs. Any small design changes in primary packaging can improve the end user satisfaction in terms of ease of use (Volmink, 2013). Since the primary packaging comes in direct contact with the end user (Pålsson, 2012), the spout design plays an important role in the performance of the packaging design.

The packaging scorecard is a good tool that assists in ranking the performance of relevant packaging designs. Strengths and weaknesses of the packaging system can be identified using the packaging scorecard (Ols mats & Dominic, 2003). The packaging scorecard is criticised as the weighting of the packaging criteria is hard for respondents to estimate and the scores are more objective than subjective (Eriksson & Towman, 2004). However, this criticism can be overcome by applying the packaging scorecard to a specific packaging level (primary, secondary or tertiary) and by making comparisons to different packaging designs over the different role players in the supply chain (Towman, 2013).

2.2.4. Packaging Impact Evaluation Tool (PIQET)

The Packaging Impact Evaluation Tool (PIQET) is an evaluation tool that provides a packaging supply chain with a quick and credible ecological assessment, which can support packaging developers or packaging designers to make decisions on packaging development and innovation strategies (Majumdar, 2007). It measures several environmental impacts of packaging and other packaging properties based on the consumer knowledge of the packaging (Svanes *et al.*, 2010).

The PIQET enables packaging professionals to provide reliable suggestions about current or anticipated environmental performance indicators to support the decision-making process towards defining and implementing their packaging performance and environmental requirements (Sonneveld *et al.*, 2005).

The decisions (towards defining and implementing the packaging performance and environmental requirements) include selection of materials for packaging redesign or packaging innovation. The PIQET is also web-based (like the COMPASS) and considers all the levels of packaging (primary, secondary, and tertiary) with emphasis on environmental factors (Majumdar, 2007). In addition, the PIQET can evaluate new or existing packaging systems over the entire life cycle of the packaging system and integrate environmental decisions into the packaging design and development process (Majumdar, 2007). Applications of this evaluation tool include material selection, packaging redesign or packaging innovation, and procurement specifications for inbound packaged goods (Sonneveld *et al.*, 2005).

The PIQET evaluates the environmental impact throughout the life cycle of the packaging system. It provides solutions to select material for the packaging system (inbound and outbound) that assists to define the packaging strategy and sustainability. The PIQET evaluates packaging criteria that are required for this research but do not take into account the practical aspects and other parts of the distribution chain.

2.2.5. Choosing the best packaging evaluation model

When considering the above-mentioned four packaging evaluation models, one of the four should at least be able to identify the criteria on which the packaging performs poorly and which affect the packaging efficiency as this is required by research question one. The packaging efficiency for the different supply chain actors were listed earlier in this section. There are four elements, depicted in *Table 2.4*, which each evaluation model should satisfy. These five elements list whether the evaluation models can do scoring, analyse packaging criteria, consider efficiency and effectiveness, and compare different packages.

As seen in *Table 2.4*, the packaging scorecard is the only evaluation model that satisfies the elements required by research question one. The packaging scorecard is able to score packaging systems, analyse different packaging criteria, consider logistics efficiency and effectiveness, compare packaging designs and consider all the packaging levels.

Table 2.4: Elements in terms of which the packaging evaluation tools measure packaging designs.

	LCA	COMPASS	Packaging Scorecard	PIQET
Scoring			●	
Packaging Criteria			●	●
Efficiency and effectiveness			●	
Compare Packages	●	●	●	●
All Packaging Levels			●	●

Hence, according to Pålsson (2013), the methodological steps to implement a packaging scorecard are as follows:

1. Interviews with selected staff;
2. Observations based on outcomes of interviews – weighting criteria and performance scores;
3. Graphical presentation of results;
4. Analysis of improvements; and
5. Identification of trade-offs.

According to Dominic and Olsmats (2001), the packaging scorecard needs to be distributed to various people in the supply chain that have considerable knowledge of packaging in their respective industries or to the consumers of the product and the packaging. The relevant people chosen should then weight the packaging criteria on a scale of 0%–100% (Dominic & Olsmats, 2001). These packaging criteria are illustrated in *Appendix C: Packaging Criteria* identified by Olsmats and Dominic (2003). The packaging criteria are for the respective role players in the supply chain, which consists of the supplier, transportation distribution and wholesale, retail, and the consumers. The criteria can be preselected but the respondents to the evaluation form may add or ignore any criteria that they feel are relevant or not relevant (Dominic and Olsmats, 2001). The weighted criteria can then be normalised. The normalised weighting can be presented as a percentage and it indicates a relevant percentage for each set criteria.

For this research, the packaging criteria were given to the respondents according to the criteria identified by Dominic and Olsmats (2001). The different packaging criteria chosen

for each role player as well as the adjusted packaging scorecard for each role player are shown in the Appendices. The packaging criteria and scorecard chosen for the retailers are depicted in *Appendix E: Adjusted Packaging Scorecard for the Six Different Packaging Designs completed by Retailers* and the packaging criteria and scorecard chosen for the consumers is depicted in *Appendix F: Adjusted Packaging Scorecard for the Seven Different Packaging Designs completed by the Consumers*.

Next the respondents can evaluate their own packaging performance for each criteria set above (Dominic & Olsmats, 2001). The adjusted packaging scorecards used in this research allow for the scoring of seven different carton designs, each making use of its own spout design. Each packaging design can be scored as follows:

- 0 – not applicable for the package
- 1 – not approved
- 2 – approved
- 3 – well approved
- 4 – met excellently

The normalised weighting can now be multiplied by these evaluation criteria and thereafter summed to a weighted average packaging score. This score will give an indication of how well the packaging is performing at the relevant links of the supply chain (Dominic & Olsmats, 2001).

2.2.6. Summary of section two

To conclude this section, all the plausible packaging evaluation tools were discussed. The best evaluation tool chosen for this research was the packaging scorecard. The title of this research suggests that packaging criteria, which affect packaging efficiency, should be identified. Therefore, the packaging scorecard is the best evaluation tool to evaluate packaging efficiency.

2.3. Sustainable Packaging

The contents left in food and beverage packaging has severe impacts on the environment since they may contaminate the surroundings (Cape Business News, 2015). New packaging

designs using environmentally friendly materials and processes are important to the concept of sustainability, but protecting the product from damage or spoilage may have a far greater environmental impact than the packaging itself (Pålsson *et al.*, 2011). Packaging that has been designed in the first place to reduce degradation will reduce the environmental problems and is therefore a more sustainable solution for the future (Svanes *et al.*, 2010).

To determine how sustainable development can be achieved, K. F. Wiersum (cited in Anon., 1995) studied forest management and sustainability from records up to 200 years old. The research suggested that there are some conflicts between the ecosystems and social systems. Wiersum (cited in Anon., 1995) concluded that sustainable forestry is possible only with practical regulation of the ecosystems and the social systems. The latter regulation is applicable to the sustainable development in the packaging environment when packaging development is implemented.

In sustainable development, the need to consider the product/packaging system as a whole and the need to consider the entire product life cycle are important (Sonneveld *et al.*, 2005). Many companies believe that since they manufacture a product that is ultimately used by the consumers, it is obvious that consumers should carry the cost of the effect the packaging has on the environment (Coles & Beharrell, 1990). However, consumers disagree with this statement. According to a survey done in China, the USA, the UK, and Germany, more than 80% of the consumers interviewed agreed that it is the manufacturers' responsibility to produce more environmentally friendly packaging, without passing along costs to shoppers/consumers (Olander-Roese & Nilsson, 2009). At the moment many companies invest large amounts of money to be more eco-friendly (Young, 2008). IKEA, a Swedish company that designs and sells mostly home accessories is a forerunner in the packaging industry (IKEA, 2015; Pålsson, 2012) and has the mindset that they are responsible for the packaging until it is no longer required by the consumer or at the point where it is reused or disposed of (Olander-Roese & Nilsson, 2009; Towman, 2013). Even if a new packaging design and its components increase the environmental impact (in terms of kg.CO₂) it should be weighed not only against packaging waste, but against the impact it has (in terms of kg per CO₂) on product and packaging waste. According to Williams (2013), this is the way new packaging design should be measured and compared in order to obtain environmentally sustainable packaging. An example of this measurement and how it should be approached is illustrated in *Table 2.5*.

It is evident that the new packaging design has higher environmental impact from the new materials. However, since there is a reduction in the amount of content waste from packaging design, it may significantly reduce the environmental impact of the new packaging design. This packaging criterion in this research is called *product remaining in packaging*.

Table 2.5: Reducing product and packaging waste by reducing food content waste.

Old Packaging Design		New Packaging Design	
Component	Impact on environment	Component	Impact on environment
Plastic Lid	3kg.CO ₂	Plastic Lid	3.2kg.CO ₂
Air Space	1kg.CO ₂	Air Space	1.6kg.CO ₂
Materials used	4kg.CO ₂	Materials used	5kg.CO ₂
Printing	2kg.CO ₂	Printing	2kg.CO ₂
Total Packaging Waste	10kg.CO ₂	Total Packaging Waste	11.8kg.CO ₂
Difference = 1.8kg.CO ₂			
Food Content Waste	3kg.CO ₂	Food Content Waste	0.9kg.CO ₂
Total Product and Packaging Waste	13kg.CO ₂	Total Product and Packaging Waste	12.7kg.CO ₂

Source: (Williams *et al.*, 2008)

According to Bruntland (1987), sustainable development meets the needs of the current generation without compromising the ability of future generations. This involves addressing the fact that environmental, social, and economic factors are interdependent in an organisation's decision-making activities (European Council, 2006). These factors form the basic strategy for a sustainable development society.

The environmental factor ensures a high level of protection and improvement of the quality of the environment and the safeguarding of the planet's natural resources (European Council, 2006). The social factor combats discrimination in all forms and promotes health and safety of the people (European Council, 2006). The economic factor promotes a living environment of a high standard in creating economic wealth through profits and employment of high quality (European Council, 2006).

Sustainable packaging decisions and evaluations have two key research streams, namely modification of existing packaging systems (packaging redesign) and/or design of new packaging systems (Pålsson *et al.*, 2011). These two streams fit the objectives of this study. Research on existing product design systems involves economic and environmental models such as a Life Cycle Analysis (LCA) or a Packaging Scorecard (Pålsson *et al.*, 2011). The innovation of a new packaging design, however, involves factors that should be considered in the design phase and preferably in designing sustainable packaging systems (Pålsson *et al.*, 2011).

Sustainable development also differentiates between different levels of concern, which range from the macro levels of society (prosperity and well-being), the intermediate levels of the product/packaging system (efficiency and effectiveness, including product waste prevention) to the micro levels of packaging materials (closed cycles or zero waste) and packaging components (safe or non-toxic) (Sonneveld *et al.*, 2005). The research will specifically focus on the intermediate levels of the product and packaging system (efficiency and effectiveness) and how new packaging design combined with logistics can influence these levels. Therefore, packaging will support sustainable development if certain principles are met (James *et al.*, 2005). Two of these principles are efficiency and effectiveness, which were discussed earlier.

The Sustainable Packaging Alliance (SPA) also found the need for developing an integrated supply chain-focused approach to research and the need for education about continued changes and improvement in packaging sustainability (James *et al.*, 2005). Some factors to consider in the sustainability of the supply chain when dealing with sustainable packaging are identified by James *et al.* (2005), Singh (2010), Pålsson (2012), and Ichikawa (2013). These factors are depicted in *Table 2.6*.

The most common factors are reduced use of resources, development in the distribution of packaging, and reducing the waste in return logistics. From a packaging design point of view, these factors can be influenced by packaging criteria that focus on stackability. Stackability, in terms of primary packaging, can be improved by making changes to the carton design or the spout design.

Ensuring that the factors are considered when developing a packaging system, it could improve effective space utilisation, improve the coefficient of fullness, reduce supply chain costs, and ultimately satisfy the needs throughout the supply chain (Pålsson, 2012). Therefore, it is good to ensure that these factors are satisfied when making changes or

improvements to a packaging design, which will in return improve sustainability of the package or packaging system.

Table 2.6: Factors to consider when dealing with sustainable packaging development.

	James <i>et al.</i> (2005)	Singh (2010)	Pålsson (2012)	Ichikawa (2013)
Reduced use of resources		•	•	•
Transport Cost		•		
Environmental Impact of Material used		•	•	
Consumer Behaviour	•			
Spending Trends	•			
Market Segmentation	•			•
Development in Distribution	•		•	•
Reduce Waste with Return Logistics		•	•	•
Increasing Shelf Life				•
Resealable Spout Design				•

Sources: (James *et al.*, 2005; Pålsson, 2012; Singh, 2010)

To summarise section three, it will be beneficial to include the environmental impact as a concern in the decision-making process when considering packaging design changes. Sustainable packaging designs should be considered at the beginning of the packaging design and development process. The information in *Table 2.6* suggested that the “reduce waste with return logistics” factor affects the packaging criterion known as stackability. It is an important criterion to focus on when considering the environmental impact of packaging development.

2.4. Deduction made from Literature

The literature presented in this chapter was concluded with the goal to gain a deeper understanding regarding the thoughts and themes identified in the research topic. It can be argued that **section one** (the packaging integration with product development, logistics and the supply chain) can be a useful decision-making contributor towards the early stages of packaging development. It can be concluded that the above-mentioned integration may

contribute to effective packaging design and development. Integration should be done early on in order to gain a holistic view of the supply chain. Furthermore, it can be argued that in order to gain effective packaging design and development, certain packaging criteria can be identified.

Gaining packaging efficiency is possible only if a packaging evaluation model can be used to identify the packaging criteria. **Section two** therefore identified the packaging scorecard as a viable tool to identify packaging criteria linked to efficiency. Gaining packaging efficiency is also linked to research question one.

When developing or designing new packaging it, should be considered to be sustainable and reduce the environmental impact. **Section three** of the literature review covered the environmental issues and highlighted the importance of keeping sustainability in mind for packaging development. According to the literature, it was found that an intermediate level of concern in sustainable development increases the efficiency and effectiveness of the product and packaging. The environmental factor of sustainability can be a good decision-making process when considering a packaging design.

Chapter 3: Key Literature for Secondary Data Analysis

The literature behind packaging design and development is an important factor for this study since it directly affects the outcomes of research question two. In this section, all the different development processes identified during the time horizon of this research is discussed and summarised. The goal is to gain knowledge regarding the current development processes that are being used in the field or future processes that are considered or discussed in the academic field.

Any industry, including the packaging industry, grows at such a remarkable rate thanks to modern technology. New materials are developed continuously and therefore new production processes are introduced (Bramklev, 2007). 3D printing also has a remarkable effect on the production process since more and more people have access to this amazing technology. In term of older and more mature areas (such as glass and metal packages), the production changes are minor. Areas such as graphic art, printing, plastic materials, plastic moulding methods, production machinery and processes, and, of course, as previously mentioned, 3D printing are some of the important technologies that change frequently (Bramklev, 2007).

Traditionally, packaging design and development only started when a new product is ready for production and distribution and focused solely on reducing the costs and not on adding value (Olander-Roese & Nilsson, 2009). Innovative packaging development is important when considering the competitive edge it provides through products and services, which will in turn increase market share and profitability (Lockamy III, 1995). Furthermore, some companies in the market are aware of the importance of packaging from a logistics and marketing point of view, but considerations are not always made for it during the development of a product (Olander-Roese & Nilsson, 2009; Bramklev, 2007b).

Packaging design has been developed as an integrated process in companies, both hypothetically and practically (Svanes *et al.*, 2010). Design and development is important for companies to be competitive (Roozenburg & Eekels, 1995). Not only will these affect the product itself, but also the packaging design for that specific product. Focusing only on the development process, and not the supply chain, may result in long lead times and a costly supply chain (Gupta & Dutta, 1994). Therefore, the product development process or the new product design ultimately affects logistics activities throughout the whole supply chain (Bowersox & Closs, 1996). The probability of a successful new product development

increases as the efficiency of the supply chain, in terms of supply chain considerations, increases (Gadde *et al.*, 2002; Hatch & Badinelli, 1999). Furthermore, according to Abassi (2013), new packaging design can contribute to the supply chain or the logistical functions through:

- Weight of materials
- Ergonomical gains
- Material regularity (in terms of design)
- Economic gains
- Environmental gains
- Marketing
- Non-economic aspects
- Retailer Shelves

Some suppliers of aseptic cartons and plastic manufacturers are competing for market share (Volmink, 2013). They compete, amongst other things, in terms of carbon footprint, shelf life, safety for consumers, and trying to sell the products to the manufacturers and customers. Seeing that the packaging design is the same as the competitors' packaging design, as mentioned earlier, any slight changes, by means of reconfiguring the design, to distinguish you from the competitor can be beneficial (Collins II, 2015; Volmink, 2013). Packaging designers should provide beverage packaging solutions that are designed with the product's end of life in mind and that facilitates the recycling process of that packaging (Cape Business News, 2015). The latter contributes to the sustainability of packaging. However, the costs involved to create designed to recycle packaging are a major obstacle in South Africa (Cape Business News, 2015).

Klevås *et al.* (2012) and Bramklev (2007 cited in Olander-Roese & Nilsson, 2009) suggest that the product development process and the packaging development process should be integrated and developed simultaneously. The packaging design phase should occur early on in the product development process. Here, the supply chain requirements (time, quality, and cost) and the logistical requirements (transport system, inventory system, warehousing system, and order processing system) should be included in the decision-making process. These were discussed in the Packaging Integration with the Product Development section in chapter two. In addition, they will be beneficial for the packaging and product to be seen as

one unit and can therefore have beneficial aspects towards satisfying supply chain and packaging efficiency and effectiveness needs (Bramklev, 2007; Sohrabpour, 2012).

There are different package development process features that are defined by the environment in which they are developed. There are also development process procedures, which are market pull-orientated (a company that supplies its own produced packages to the customer's facilities without providing the whole packaging system), process-intensive (mounting and filling at the customer's facility is usually the final production process step and therefore the design is specific for this reason), quick-build (several teams work side by side on different systems of the entire package), and complex and systemic (structuring the development process into subsystems in order to integrate the design activities of two different objects) (Bramklev, 2007).

Packaging development is executed by personnel who are involved in a product-developing company or by a package development company, where the latter is normally a supplier to a product-developing company (Bramklev, 2007). Packaging development from a packaging supplier's point of view begins by identifying whether there is a need to change the packaging design (Björck, 2013). This is usually done by considering requests from customers (i.e. product manufacturers), analysing changes in demand, and conducting macro studies at a generic new development level (Björck, 2013). A change in the packaging system should be measured against the change that will be required throughout the whole supply chain and ultimately not affect the efficiency of the supply chain system (Björck, 2013).

A new packaging or product development phase is administered in terms of the flexibility of the packing machines (Volmink, 2013). The responsiveness of quick changeovers from one packaging system to another can be a costly process and it may also disturb the manufacturing process (Volmink, 2013).

It is important to note that every manmade product goes through several processes from the origin of the product to the disposal of the product materials (Bramklev, 2007). This life cycle is designed by Olsson (1976 cited in Bramklev, 2007) and is illustrated in *Figure 3.1*. It can be noted that the life cycle should go as far as the disposal of the product or packaging. It will be beneficial to add the disposal of the product or packaging to the packaging development process as part of the mandatory phases.

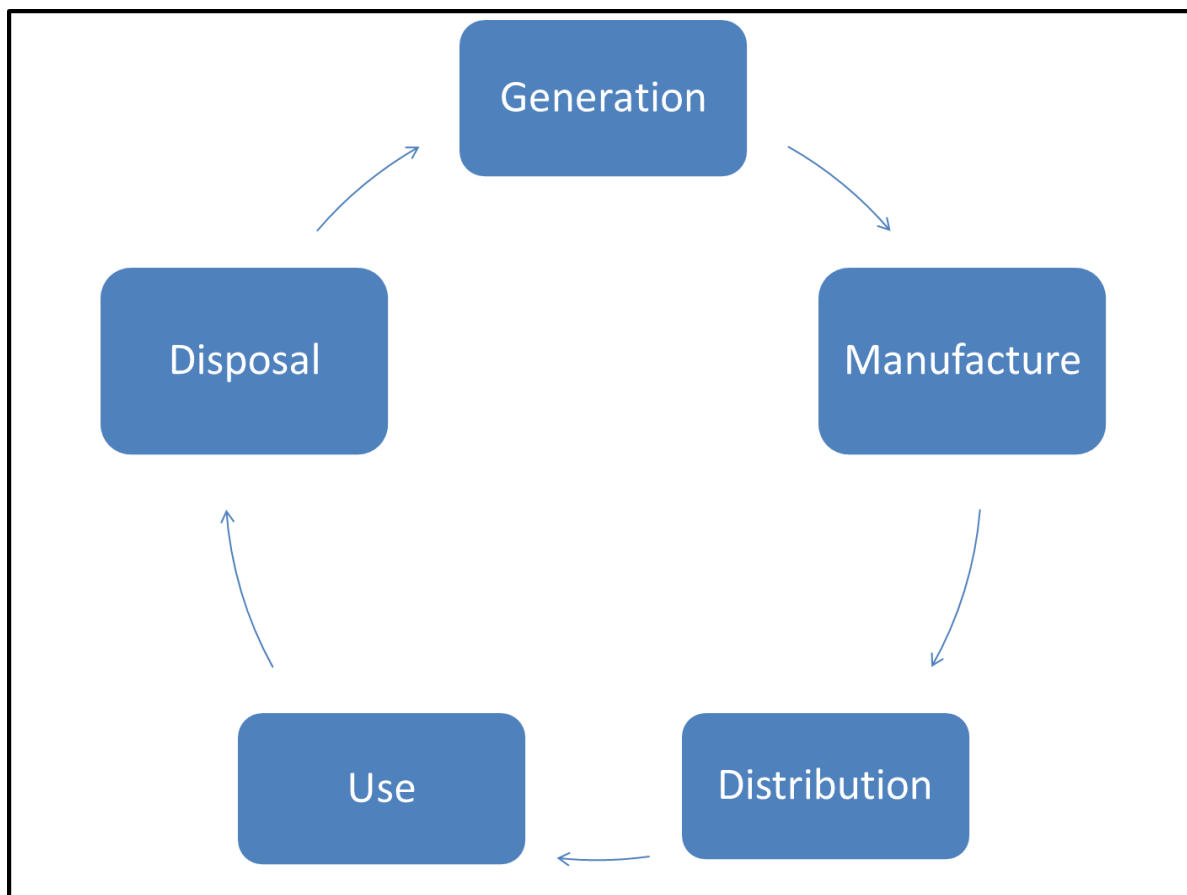


Figure 3.1: Product or Packaging development life cycle.

Source: (Bramklev, 2007)

According to Bramklev (2007), the final packaging design should be established through a development process and the phases and activities in the process should replicate the goal of the project. Because the product is dependent on the packaging design, there are strong interests and needs to implement and develop an integrated procedure model for the packaging industry (Bramklev, 2007). The latter clarifies that a specific package that is required in the market requires a specific packaging development process (Bramklev, 2007). For example: the packaging development process for a 1-litre polyethylene terephthalate (PET) bottle will be different from the packaging development process of a 1-litre aseptic carton, even if the carton contains the same contents or is eventually used for the same purpose.

According to Pålsson *et al.* (2011), a choice of packaging is vital when the environment and logistics are key role players in the design. Existing packaging systems require models to evaluate the status quo to be able to identify where packaging configurations are necessary. These models can be either a Life Cycle Analysis (LCA), a packaging scorecard (Pålsson *et al.*, 2011), or a Comparative Packaging Assessment and Packaging Impact Evaluation Tool

(PIQET) (Selke & Aurus, 2013). These evaluation models were discussed earlier in this chapter. Hence, if these configurations need to be implemented, it needs to be done with a design and development process.

The present study is concerned with analysing specifically chosen design and development processes. These processes were chosen because of the validity in the packaging field, the validity to answer the research questions, and the year the specific development processes was developed. Other development/innovation theories do exist, but were not relevant for this research since they were either outdated or replaced by better processes.

3.1. Packaging Development Process at a Product Manufacturer in South Africa

When thinking of packaging design and development, considerations should be made regarding the packaging being seen as a unit that connects with the consumer through the desirability and accessibility of the packaging (Taylor, 2013). Desirability consists of the packaging design and accessibility of the product in terms of, for example, demographics, age, and gender. Seeing that 75% of the fruit juice cartons are bought by women, a product manufacturer needs to think in terms of adapting to that specific market (Volmink, 2013). New product development is governed by the adaptability of the packing machines.

This product manufacturer has an innovation meeting once a month where the marketing department or the research and development department introduces new ideas or products they want to launch. There are specific steps and set criteria that should be followed for this process. Throughout this process, every step should be approved. The process is also called the ideas funnel (Volmink, 2013). These steps are depicted in *Figure 3.2*. This is idea generation where the product manufacturer decides what should be done and motivates the decisions.

In the ideas funnel, the following can be seen:

- *Project proposal* is concerned with whether it is viable and makes sense.
- *Development Stage and business case* refer to a small-scale trial, taste test, costs for packaging and product, and weigh all costs involved to see if product is viable to launch in the market.

- *Pre-industrial stage* is concerned with whether it can be done in the factory and entails a factory trial.
- Write a *launch plan* that starts production.
- *Post launch review* is done after six months on the project to assess the progress of the project.

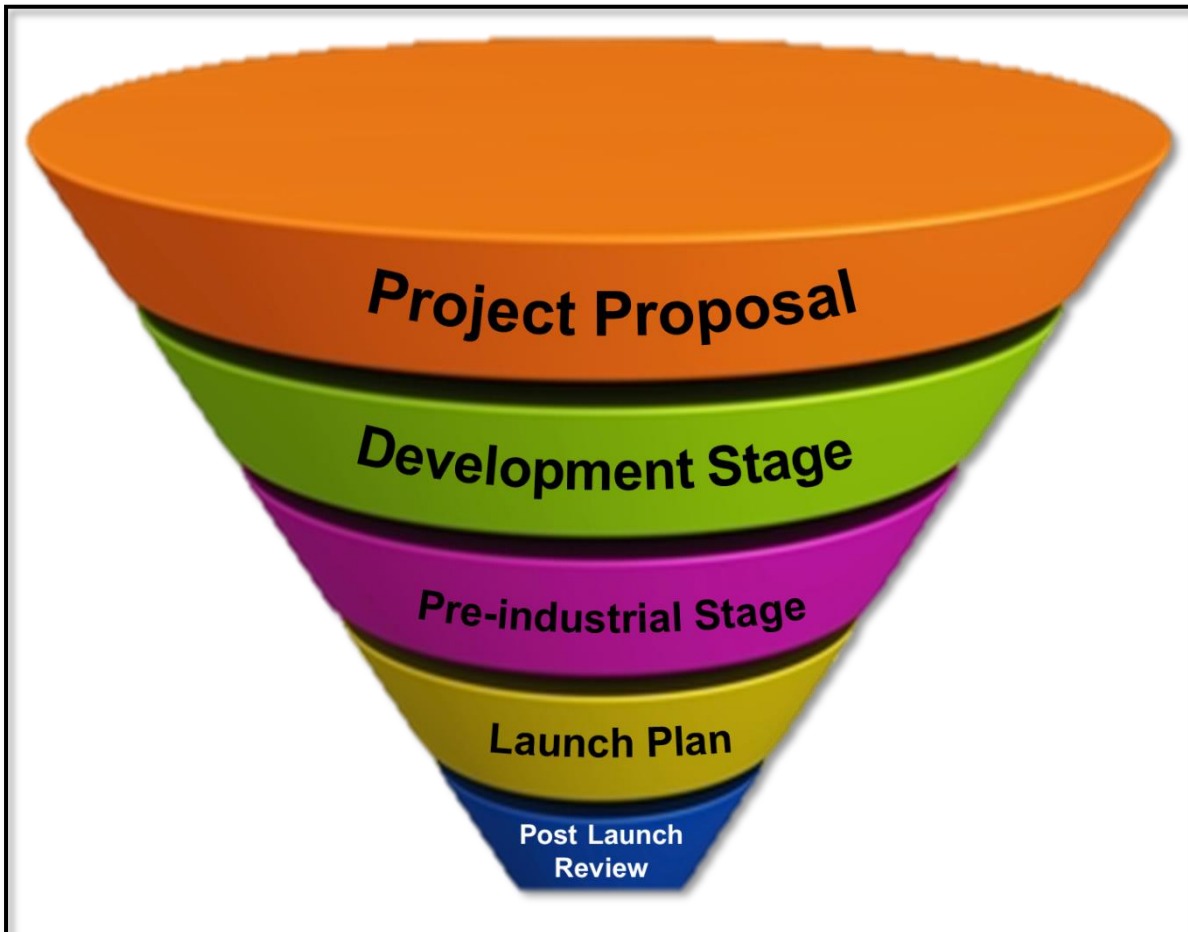


Figure 3.2: Ideas Funnel to develop a new packaging design at a product manufacturer in South Africa.

Source: (Volmink, 2013)

Hence, after the ideas funnel is completed, Volmink (2013) suggests the packaging development process from a product manufacturer's point of view as depicted in *Figure 3.3*. As soon as a new packaging design is proposed by a packaging manufacturer, the packaging developers of the customers (product manufacturers) study the feasibility of implementing the new design. There are various steps that should be followed within the research-and-development process and the approvals for any project or new product that will be implemented.

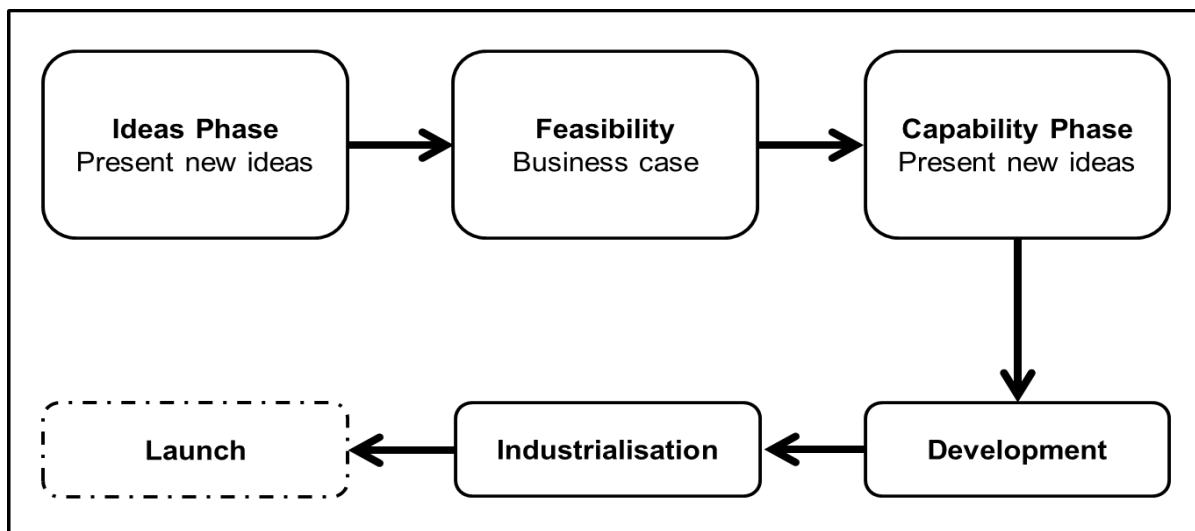


Figure 3.3: Package Development process at a product manufacturer in South Africa.
Source: (Volmink, 2013)

According to Volmink (2013), these steps start out as an **ideas phase** with the customer. The new ideas will then be presented. After the ideas stage has been completed, the customer will check the feasibility of the ideas. During this **feasibility phase**, there will be a business case study from the marketing side. This case study will cover all the costs and check if the new product will be viable to implement in the business. They will also make sure that the new product will be able to increase the sales volume and be profitable and ultimately create a satisfactory return on investment. Furthermore, Volmink, (2013) explains that the **capability phase** follows the feasibility phase and if the project seems capable to be satisfactory, it moves onto the **development phase** and from development to **industrialisation** and then the final phase, which is the **launch phase**.

A product manufacturer should try to collaborate with the packaging manufacturer during these stages since the whole process can become very expensive (Volmink, 2013). A new packaging design often requires a new machine, new sterilisation equipment, machines that should do all the forming of the cartons and the end-of-line equipment that all adds up to a high cost of capital for which the product manufacturer is liable (Volmink, 2013). It would therefore be beneficial to consider redesigning existing packaging designs.

3.2. Packaging Development Processes by different scholars

There are a few operational procedure models for the package development process (Bramklev, 2007). Descriptions of operational methods are not available, but are required to

resolve important issues that are present during the development activities. The packaging development processes are illustrated by Briston and Neill (1972), Griffin, Sacharow and Brody (1985), Frank A. Paine (1990), DeMaria (2000) and Roland Klooster (2002) which are all cited by Bramklev (2007).

These packaging development processes are summarised by the intended use or the package to be developed, the start of the procedure activities, end-of-the-procedure activities and then phases and paths (where applicable), which follow *Table 3.1*. It is important to be aware that these packaging development processes are older development processes based on either product development processes or a combination of product and packaging development processes. Some of the terminology makes use of the term package and not packaging.

Table 3.1: Summary of development process identified by academics.

	A	B	C	D	E	F
	Briston & Neill (1972)	Griffin, Sacharow and Brody (1985)	Frank A. Paine (1990)	Soroka (1997)	DeMaria (2000)	Roland Klooster (2002)
Intended Use	All managers concerned with packaging	Packaging designers and managers	Packaging designers and managers	Guideline to students	Packaging designers and managers	Packaging designers and managers
Package to be	Difficult to define	Any packaging type	Any packaging type	Any packaging type	Unknown	Any packaging type
Start of Procedure	Objective of developing a package	Motives for developing a package	Product needs and idea generation	Product needs and idea generation	Business planning and vision of project	Business planning and vision of project
End of Procedure	Full design description	Full design description	Full design description	Full design description	Launch of package	Design proposal
Phases	<ul style="list-style-type: none"> • Planning • Execution 		<ul style="list-style-type: none"> • Concept • Preliminary sorting • Prototyping • Package engineering evaluation • Package evaluation 	<ul style="list-style-type: none"> • Project initiation • Information development • Development and testing alternatives • Proposals • Decisions • Drawing up specifications • Implementation 	<ul style="list-style-type: none"> • Planning • Proving functionality • Package launch 	<ul style="list-style-type: none"> • Analysis • Synthesis • Simulations • Evaluation • Detailing
Paths		<ul style="list-style-type: none"> • Total system path • Package development path 				

Sources: (Briston & Neill, 1972; Griffin *et al.*, 1985; Paine, 1990; Soroka, 1997; DeMaria, 2000; ten Klooster, 2002)

3.3. Packaging Development Process by Bramklev (2007)

Usually, processes begin with the request for packaging or alternate packaging solution. The request usually comes from customers who seek a solution to the packaging obstacle (Björck, 2013) or require changes to current packaging systems (Bramklev, 2007). These changes in the design of a package may affect the whole supply chain (Hellström & Saghir, 2007).

According to Bramklev (2007), there are two development processes namely generic and complex. A generic package development process is a set of activities that will ensure that a packaging design will be developed in such a way that it can be marketed and produced for any packaging type. For a complex development process, it may happen that different types of packaging designs are required. The eventual difference between a generic development process and a complex development process can be seen in *Figure 3.4*. The basic difference can be seen from the beginning of *Figure 3.4*. A generic development process entails packaging development processes that are all the same, whereas a complex development process has a combination of different packaging development processes.

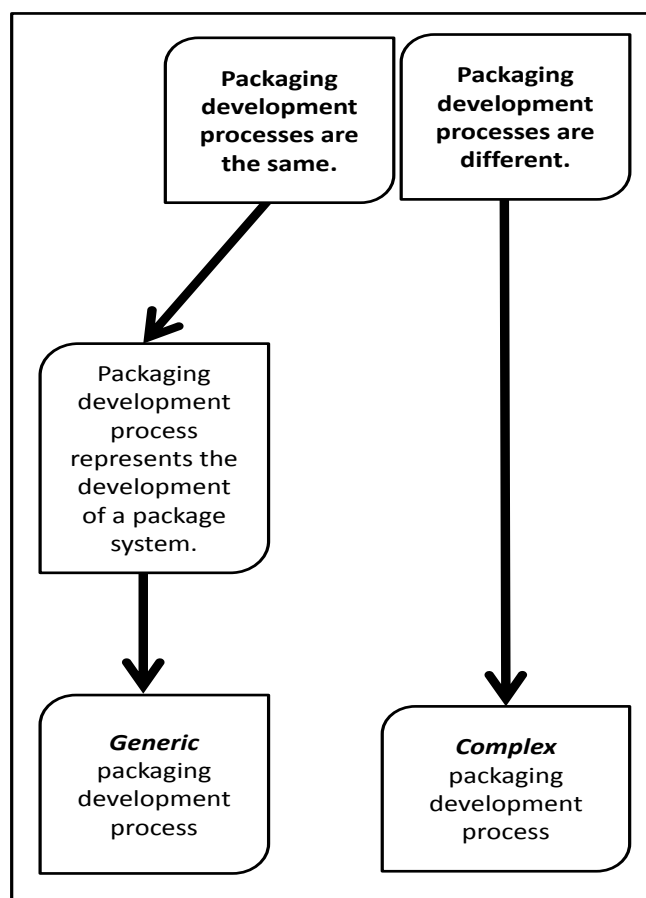


Figure 3.4: Complex vs generic package development process.

Source: (Bramklev, 2007)

The proposed packaging development process by Bramklev (2009) can be summarised in seven phases that are illustrated in *Figure 3.5*. Each phase carry an input and output linked to the specific phase. Furthermore, there are activities in each phase that should be accounted for before each activity can move on to the output of that specific phase (Bramklev, 2009).

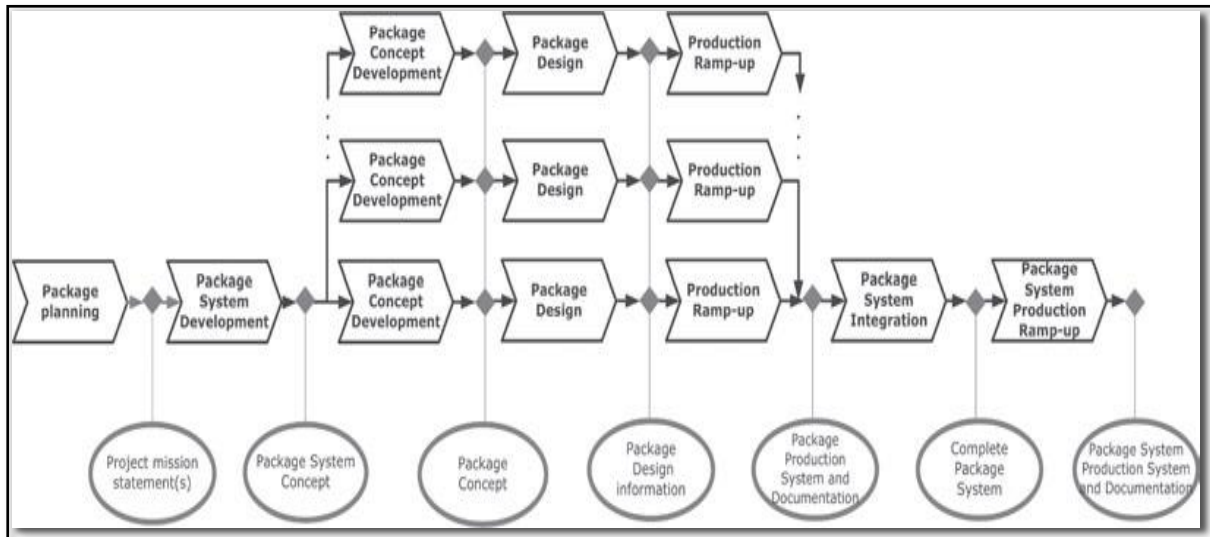


Figure 3.5: Generic packaging development process.

Source: (Bramklev, 2007b)

Phase 1: Packaging Planning

The input towards this phase is the market information required. The activity is to identify market opportunities that can be prioritised and if proven valuable, they can be allocated resources. The output is pre-project planning where the project's mission statements are developed.

Phase 2: Packaging System Development

The input towards this phase is the project mission statement or a request for a product and packaging system. The activities in this phase are analysing the mission statement, specifying the package system, generating the packaging system concepts, and identifying and selecting the subsystems. The output of this phase is the overall packaging system concept.

Phase 3: Packaging Concept Development

The input towards this phase is the information on either a subsystem or a single packaging concept. The activities in this phase are establishing packaging specifications, generating

packaging concepts, and then evaluating and selecting the packaging concepts. The output of this phase is the selection of the packaging concept.

Phase 4: Packaging Design

The input towards this phase is the packaging concept. The activities in this phase are establishing the design specifications, then building a prototype, and testing. The last activity is to evaluate and decide on a prototype. The output of this phase is the packaging design information required for the production of the packaging.

Phase 5: Production Ramp-up

The input towards this phase is the completed packaging design information. The activities in this phase are the adaptation or development of the production system(s), the development of tools for the production, the initiation of the production, and the evaluation of early production output. The output of this phase is the package production system and documentation.

Phase 6: Packaging System Integration

The input towards this phase consists of the type of outputs obtained from each of the packaging development projects. The activities in this phase consist of integration of performance parameters and the testing and evaluation of the interface between the subsystems. The output of this phase is the complete packaging system.

Phase 7: Packaging System Production Ramp-up

The input towards this phase is the packaging or subsystems creating the packaging system and the packaging integration concept. The activities in this phase are the adaptation or development of the production system and the development of the tools required for production. After initiation of the production process, the early production output is evaluated. The output of this final phase is the packaging system, production system, and documentation.

This generic packaging development process contributes towards the global aspects of packaging development and life cycle aspects (Bramklev, 2007). For a development process to be generic, it should ensure the development of new and innovative packaging systems and packaging designs (Bramklev, 2009). This increases competitiveness in the industry

especially if packaging plays a major role in establishing a unique identity to a product (Bramklev, 2009; Volmink, 2013).

3.4. Packaging Development process by Stage-Gate[®]

Stage-Gate[®] is a system to introduce new products to the market. It can be seen as a blueprint for managing new product development and insuring that it improves efficiency and effectiveness (Cooper, 2008). Cooper (2008) furthermore explains that the Stage-Gate[®] development system uses better decision-making practices by making use of scorecards, success criteria, self-managed gates, electronic and virtual gates, and integration with portfolio management. Many companies have benefitted from making use of the Stage-Gate[®] system, however there are just as many companies that tried to implement the Stage-Gate[®] system and failed.

Cooper (2008) identifies key factors about why some companies fail to successfully execute a new product development process. These key factors may also influence the decisions made about packaging development as part of the new product development process. The factors include missing steps and activities, poor organisational design and leadership, inadequate quality of execution, unreliable data, and missed timelines. This is why, according to Cooper (2008), the Stage-Gate[®] is a good system to implement since it assists in avoiding the above-mentioned factors. Cooper (2008) tries to distinguish fact from fiction regarding the perspective about the Stage-Gate[®] system and lists the following few things to distinguish why and in which environment the Stage-Gate[®] system is more beneficial:

- The Stage-Gate[®] system should not be confused with the older “phased review” systems where stages took longer to be completed since the “phased review” system runs in sequence, rather than in parallel.
- The Stage-Gate[®] system is not a rigid and lock-step system. Therefore, it does not have mandatory steps that should be followed in order to obtain the objectives, but rather a map that will guide the project team towards the end goals. This approach provides the project team an option to be flexible.
- Stage-Gate[®] is not a linear system, although the graphical representation depicts it as such. The stages loop, iterate, and overlap as the project develops.

- Stage-Gate[®] is not a control mechanism where the executives or auditors control or micro-manage the project.
- Stage-Gate[®] is not old and outdated.
- Stage-Gate[®] is not a bureaucratic system.
- Stage-Gate[®] is a data entry tool to obtain relevant data from the project process, which it is not.
- Stage-Gate[®] is not a product delivery process, but a product development process and should be implemented at the beginning of the project, not at the end.
- Stage-Gate[®] is not similar to project management as project management is a micro process and Stage-Gate[®] is a macro process. Project management is incorporated at the different stages of the Stage-Gate[®] system.

Stage-Gate[®] consists of a set of stages where information should be gathered then followed by a “Go/Kill” decision-making process or “gate”. The Stage-Gate[®] information gathering stages are depicted in *Figure 3.6*. The stages are where the project team starts the work, acquires the relevant information, and does the data analysis. The gates are where decisions are made when it is necessary to continue to invest in the project.

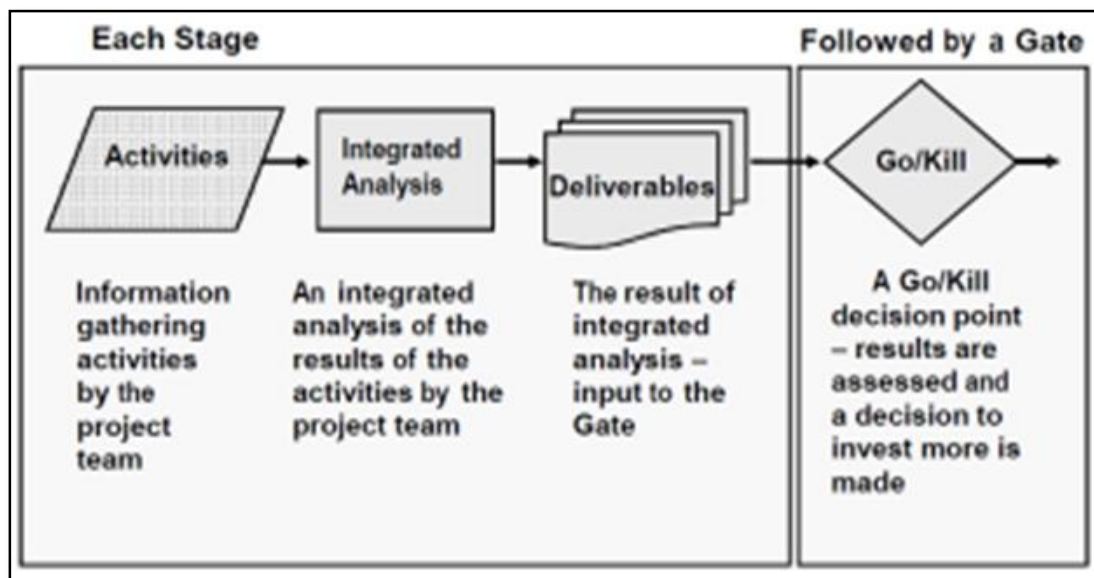


Figure 3.6: Information gathering stage in the Stage-Gate[®] system.

Source: (Cooper, 2008)

From *Figure 3.6*, it can be depicted that the Stage-Gate[®] does not promote a lot of opportunities for decision-making processes throughout the course of the Stage-Gate[®] system. Throughout the system, the project team analyses the performance and results. This can be seen at the three different stages: activities, integrated analysis, and deliverables. The

decisions are only made at a “gate” at the end of the Stage-Gate® system. A decision to invest further in the project is made, which is called the “Go/Kill” gate.

A standard Stage-Gate® system is designed for product development (Cooper, 2008). It starts with an idea stage and ends with a post-launch review. The innovation process can be explained as a series of stages, where every stage has recommended best-practice activities that are required so that the project can proceed to the next gate (Cooper, 2008). Each gate acts as a quality control checkpoint (Cooper, 2008). However, over the years, the Stage-Gate® system has evolved and changed to fit every type of risk level and requirement from the different development projects. Hence, Cooper (2008) states that the Stage-Gate® Xpress, Stage-Gate® Lite and Stage-Gate® Full systems were created to fit the specific requirements of the projects.

The Stage-Gate® Xpress is for projects that aim to make improvements, modifications, or add extensions to existing products (or packaging). The Stage-Gate® Lite “is for very small projects such as customer requests” (Cooper, 2008:11). The “NextGen Stage-Gate *Idea-to-Launch Process*” (Cooper, 2008) is shown in *Figure 3.7* where the Full Stage-Gate®, Stage-Gate® Xpress, and Stage-Gate® Lite is depicted.

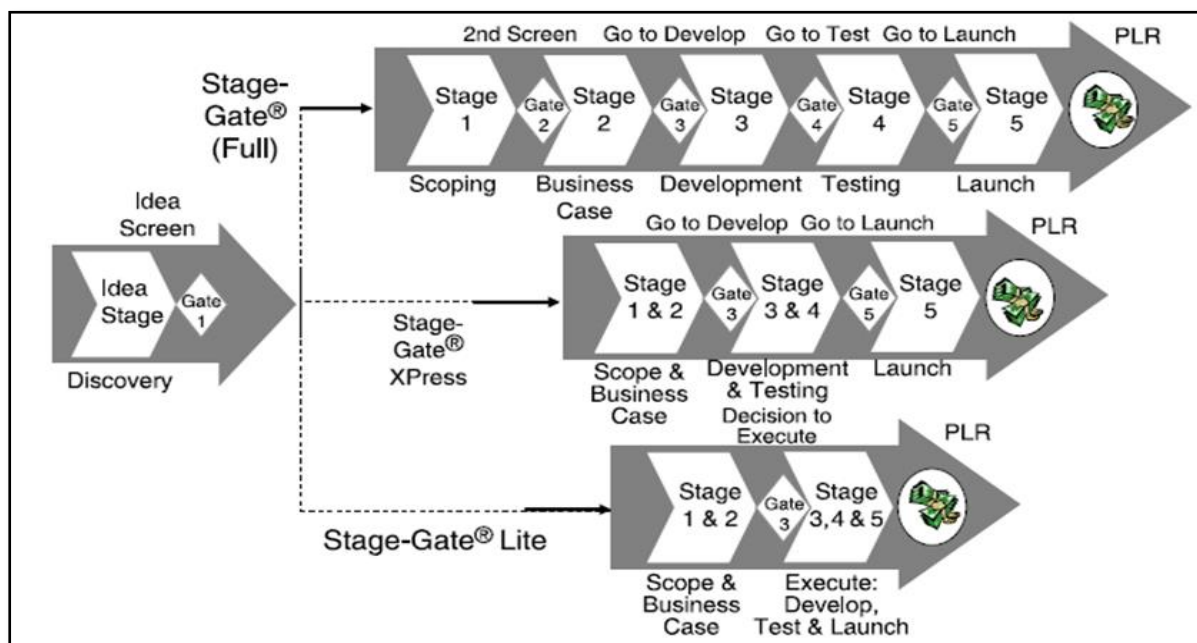


Figure 3.7: Stage-Gate® Lite, Xpress and Full.

Source: (Cooper, 2008)

As seen in *Figure 3.7*, all the development projects enter through Gate 1. This gate acts as an idea screening decision to decide which version of the three Stage-Gate® systems will fit the

project the best. The higher the risk of the development project, the more it will adhere to the Full Stage-Gate[®] system. The system is a flexible system, “no activity or deliverable is mandatory”, every project is unique, and a certain development process can be developed different to others (Cooper, 2008:12). Furthermore, it can be beneficial if a development process can be altered to fit to a package-specific development process (Bramklev, 2007).

The Stage-Gate[®] XPress, in the case of this research, will be a good development process to use to redesign or make improvements to existing aseptic carton designs. The Stage-Gate[®] XPress starts the process with a scope and business case. After passing the first gate, the decision needs to be made about whether the development process should continue to the developing and testing stage. After this stage, another gate generates the decision to go onto the launch stage. It is important to bear in mind that there should be constant communication with the project development team and the customer, which is called the spiral development (Cooper, 2008). Spiral development consists of constant build, test, feedback, and revise iterations or loops (Cooper, 2008).

3.5. Packaging Development Process by the C-K Theory

The C-K theory, designed by Hatchuel and Weil (2003), focuses more on product development and not packaging development (Gobbo & Olsson, 2010). But according to Gobbo and Olsson (2010), it can be used in the packaging field to narrow the gap between the different knowledge bases that may occur in the different field that plays a role during the development process. The C-K theory offers a step-by-step process to design creative ideas and breakthrough solutions to designers in research and development departments (Mines ParisTech, 2010).

The name of the C-K theory is based on the distinction between two spaces, i.e. a space of concepts “c” and a space of knowledge “k”. C-K Theory has three advantages over existing design theories (Hatchuel & Weil, 2003). Firstly, existing design theories are unable to account for the innovative aspects of design. Secondly, classic design theories are dependent on objects, machine designs, architecture, or industrial design. In addition, classic design theories are tailored to a specific knowledge base, which makes it difficult to adapt to real design situations. Thirdly, existing design theories have been developed as single research fields that make them vulnerable to global changes in design and creativity. The C-K theory

can therefore be used on unknown or new objects or on adjusted or redesigned objects (Hatchuel & Weil, 2003).

The first step in the C-K theory is to define the concept in terms of the distinction between the concept and the knowledge (Hatchuel & Weil, 2003). The second step is to describe the attributes that will link the knowledge to the concept. According to Mines ParisTech (2010), the knowledge space is a plan with a logical position of which is available to the designer. It describes all the objects and facts that are available regarding the object itself. The concept in turn is described as a plan without a logical position in the knowledge space. It can be seen as the starting point of the design process. Adding concepts, the designer gains the ability to move past problem-solving and add design attributes to the object. It cannot, however, be searched or explored, since it is only an idea.

According to Hatchuel and Weil (2003), there are four operators that enable the knowledge space and concepts space to develop the external operators (from $C \rightarrow K$ and from $K \rightarrow C$) and the internal operators (from $C \rightarrow C$ and from $K \rightarrow K$). These four operators in combination is called the design square, which is depicted in *Figure 3.8*. The process starts by expanding space C with elements that are derived from space K ($K \rightarrow C$). By separating the latter, new properties are added to concepts that create newer concepts ($C \rightarrow C$). This results in properties of the knowledge space to be added or subtracted, enabling a logical status of the object ($C \rightarrow K$). Finally, the knowledge space allows itself self-expansion in order to prove new theorems ($K \rightarrow K$).

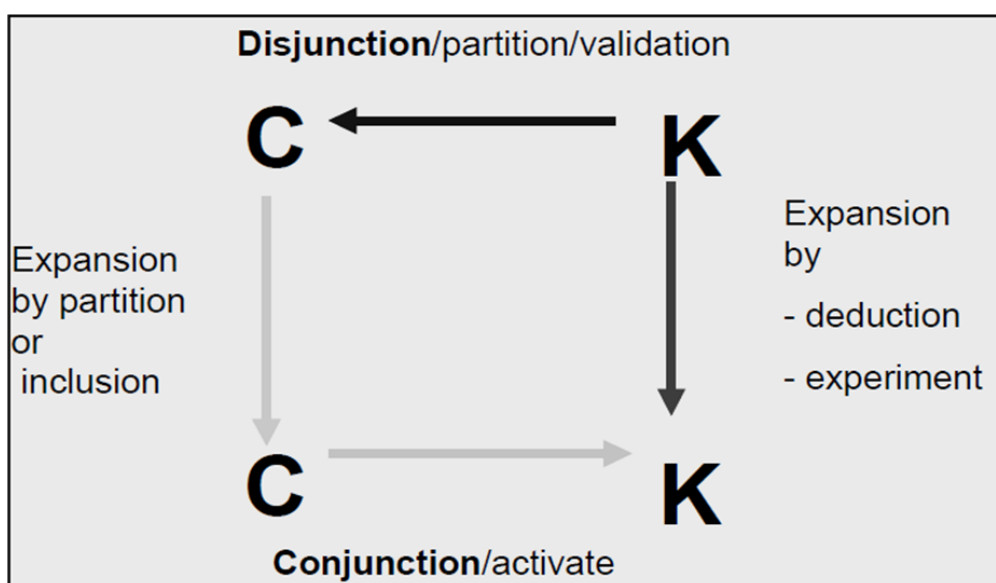


Figure 3.8: Design square of the C-K theory.

Source: (Hatchuel & Weil, 2003)

According to Hatchuel and Weil (2003), the C-K theory offers a “universal form of reasoning” that assists in expanding on what is already known in the design field. Furthermore, it allows to study the “conditions bearing on any design process” when thinking of combining or separating designs.

3.6. Packaging Development Process by Schueneman (2010)

According to Scheuneman and Tolette (2010), the packaging is always designed to increase certain features of the product. It should add special requirements to the product, while knowledge of the materials in use is crucial. The development process requires input from different disciplines and influences, which include:

- Mechanical Engineers (design and fabricate packaging filling lines)
- Electrical Engineers (control the electronics involved in the packaging manufacturing systems)
- Chemical Engineers (design and formulate barriers in flexible packaging systems)
- Graphic Art Skills (design artwork appealing to consumers)
- Marketing Skills (design the best presentation of the product through the packaging)
- Medical Skills (test packaging systems for medical devices and pharmaceuticals)

Scheuneman and Tolette (2010) identified the packaging development process depicted in *Figure 3.9*. The development process starts with the following phases:

Phase 1: Basic characteristics of the packaging

The characteristics include production, containment, utility, motivation, and convenience.

Phase 2: Requirements of the product needs

The needs have to be identified. They include the safety, toxicity, product-package compatibility, sustainability issues, and recycling.

Phase 3: Development of prototype

A prototype should be developed using the materials selected for the project. It should consider the materials, graphics, printing, technology, logistics, and the packaging filling techniques.

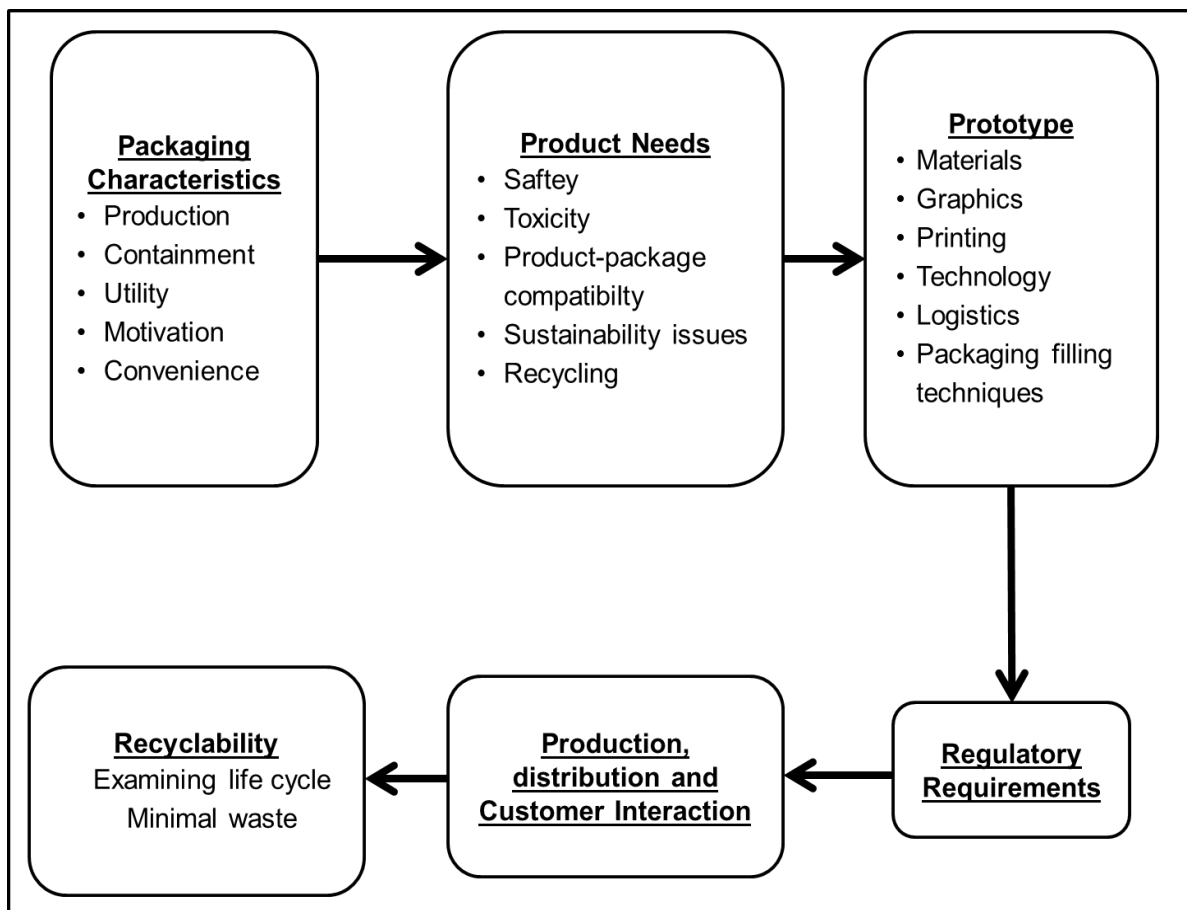


Figure 3.9: Packaging Development process by Scheuneman and Tolette.

Source: (Scheuneman & Tolette, 2010)

Phase 4: Regulatory Requirements

All the regulatory requirements should be considered and fulfilled. It can be an expensive process and should undergo thorough testing relevant to any legal requirements.

Phase 5: Production, distribution and customer interaction

The packaging will be involved in the production, distribution, and customer interactions. The packaging should be developed depending on the type of production process, distribution process, and the way it will be interacting with consumers.

Phase 6: Recyclability

The packaging should be designed using techniques that will assist in the recyclability of the packaging in terms of keeping waste to a minimum after it is disposed. This can be done by examining the life cycle of the packaging.

3.7. Packaging Development Process according to the Card Approach

The card approach is a method of identifying the performance of a packaging requirement analysis and is based on using a deck of cards (Magnusson *et al.*, 2012). It should be introduced early on in the packaging development stages when the packaging is still being conceptualised. The card approach should eventually make the packaging development process more effective (Magnusson *et al.*, 2012).

The card approach starts by categorising the different aspects of the packaging, which can be seen in *Figure 3.10*. For example:

- Secure and protect (product, packaging, and environment)
- Placement (type in store and place in store)
- Target group (life stage, character, and properties of packaging)
- Seduce and attract (competitor, pack design, marketing mix)
- Serve and please

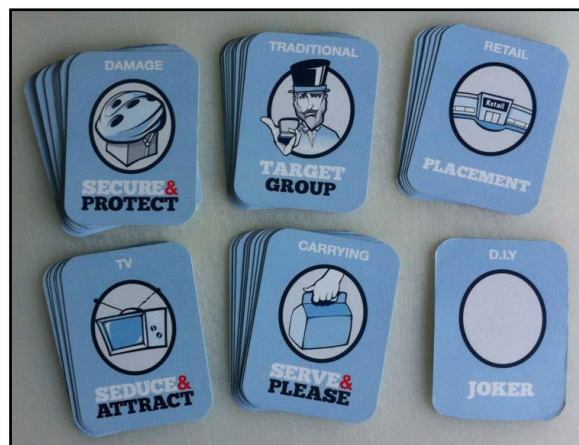


Figure 3.10: The card approach card deck divided into five categories.

Source: (Magnusson *et al.*, 2012)

According to (Magnusson, *et al.*, 2012), the joker is the final card in the deck. Its purpose is to give the customers the chance to identify important issues that have been overlooked by the five categories. The customers now have the opportunity to identify the most important aspects in a workshop. The customers choose a card that will represent the important aspect. Ultimately, the identified aspect should be captured in a database, which will give the company developing the packaging a platform to compare and choose the aspect to focus on when continuing with the development process.

According to Magnusson *et al.* (2012), the card approach creates an interactive environment, which assists in new packaging development, redesign packaging, cost optimisation of packaging, marketing of the packaging company, and internal education at the packaging company. Ultimately, if the correct questions are asked and discussed, the card approach will help customers find a packaging solution that is in accordance with the customer's demands and requirements (Magnusson *et al.*, 2012). It is not a development process, but can be a good tool to assist in improving an existing development process.

3.8. Packaging Development process by Collins (2015) – Packaging Design for Entrepreneurs

There are a lot of literature and research available on packaging or product development processes for mid-sized to large companies; however, not a lot of publications are available on the packaging development processes for new product and packaging entrepreneurial ventures (Collins II, 2015). Furthermore, Collins II (2015) claims that new product entrepreneurs do not have the knowledge or experience with packaging development processes. The packaging development and product development should be considered as a parallel activity throughout the initial development phase (Bramklev, 2007b; Collins II, 2015). According to Collins II (2015), the following events should be considered when developing a new packaigng system and can be seen in *Figure 3.11*.

Event 1: Packaging Requirements

First, a list of all the aspects that the packaging requires for marketing, product development, engineering, manufacturing, supply chain, and packaging development should be made. This should be done so that all the needs from each department are satisfied. There are different aspects for all the packaging levels, however only the primary packaging level will be considered. These requirements for all the packaging aspects are:

- Packaging costs targets (including profit and loss for all packaging components)
- Time required for completion
- Product protection requirements (throughout the whole supply chain)
- Consumer requirements (e.g. usability, handleability, and product dispensing)
- Product branding/Information requirements (artwork)
- Product visibility

- Technology capabilities/limitations
- Trade requirements (identifying and stocking)
- Legal requirements (e.g. information, warnings, and material identification)
- Barcode requirements
- Special environmental/temperature restrictions
- Packaging production processes required (internally or outsourced)
- Sustainability/Environmental considerations

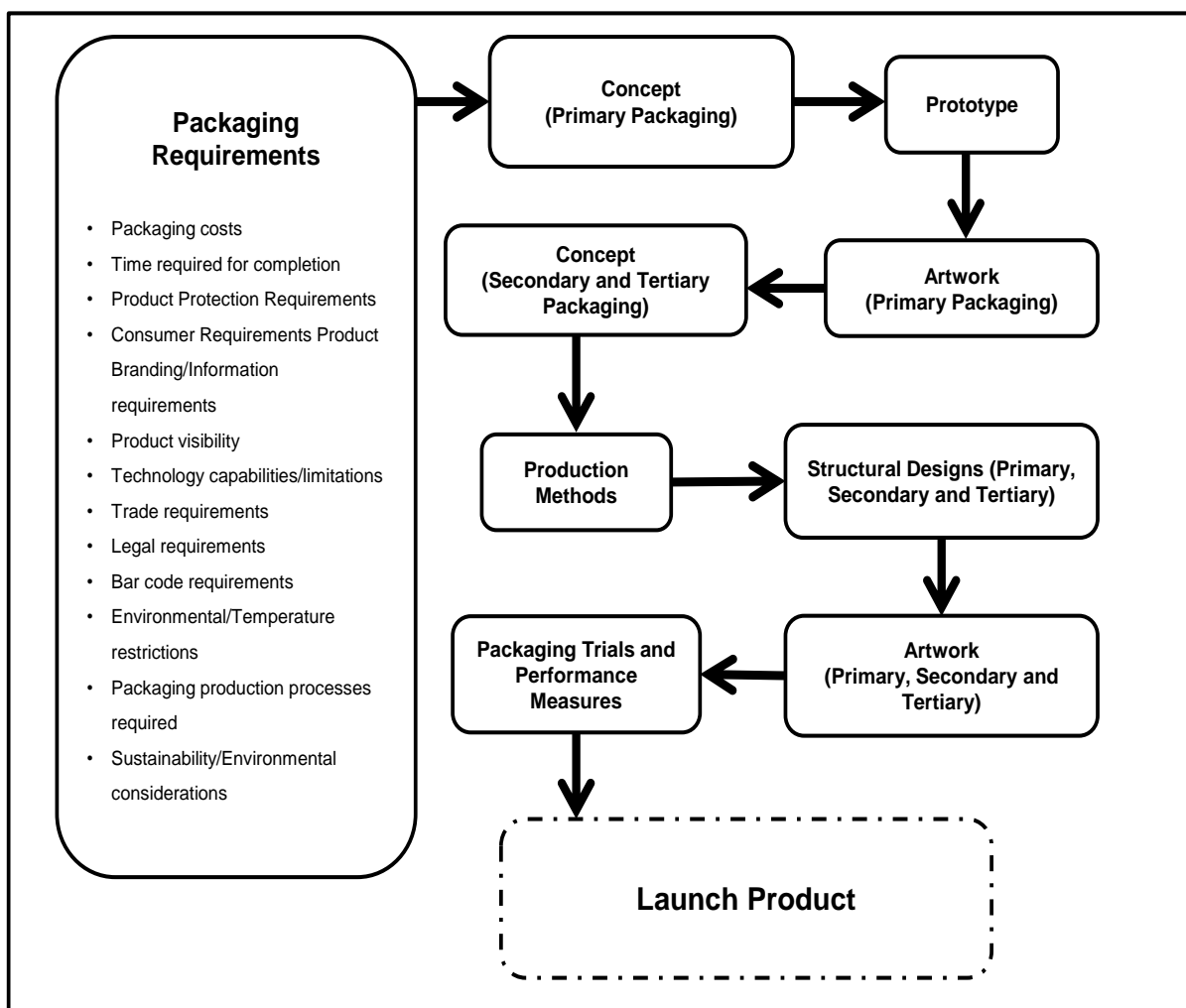


Figure 3.11: Packaging development process by Collins II.

Source: (Collins II, 2015)

Event 2: Concept

Explore concepts that will meet the requirements based on the definition of the packaging system. If there is an industry standard packaging system, this step is easy. However, if it is a brand new design and/or concept, the packaging development process is significantly more complex and a lot of experience in the field is required.

Event 3: Prototype

A structural prototype of the desired concept should be created. See if the new or improved concept meets the requirements mentioned in the first step and satisfies any compromises made throughout steps one and two.

Event 4: Artwork for primary packaging

Develop artwork concepts based on the structural concepts chosen in the third step.

Event 5: Concepts for secondary and tertiary packaging

If necessary, develop concepts and sizing for secondary and tertiary packaging designs. However, it cannot be finalised before the primary packaging design is approved.

Event 6: Production Methods

Determine the production methods and locations for the concept packaging chosen in the third step.

Event 7: Structural designs for primary, secondary, and tertiary packaging

Finalise the primary, secondary, and tertiary structural packaging designs based on the performance tests throughout the whole supply chain (from source to return).

Event 8: Artwork for secondary and tertiary packaging

Finalise the secondary and tertiary packaging artwork.

Event 9: Packaging trials and performance measures

Perform packaging trials in the relevant supply chain positions in order to confirm the satisfactory performance of the packaging processes.

Event 10: Product Launch

Begin the production and launch the product.

If only a minor change to a current design or an improvement is required, it may not be necessary to implement steps four, five, six, and eight. The advantages of the development process identified by Collins (2015), is that it considers all levels of packaging.

3.9. CAPE System

The CAPE system is palletisation software that assists in determining the best size for a product packaging, case count, case size, and pallet load (Esko-Graphics, 2015). A visual representation of the CAPE system can be seen in *Figure 3.12*. The CAPE system assists in designing new products and packaging, optimising the product arrangement and orientation, creating new or alternative secondary packaging, improving cube utilisation, improving coefficient of fullness (i.e. reducing open space between primary packages), testing strength of packaging, and calculating the impact on sustainability values (Packaging Digest, 2015; Ram, 1992).

Although CAPE systems assist in the technical aspects of new packaging design, it is also a good tool to use when considering the quantitative aspects of new packaging design (Abassi, 2013). It is not a development process, but can be a good tool to assist in improving the development process.

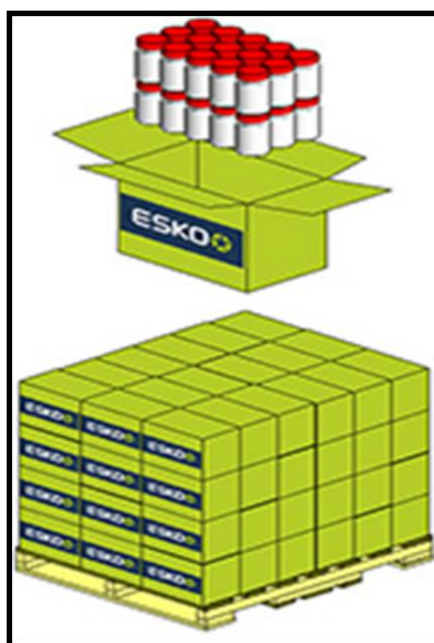


Figure 3.12: Example of the CAPE system.

Source: (Esko-Graphics, 2015)

3.10. Summary of literature for secondary data analysis

All the plausible packaging design and development processes were discussed. It should be considered if an adapted packaging development process may be the solution to improving or developing certain packaging criteria and ultimately gaining packaging efficiency that is

sustainable for the future. The different development, product development, and package development processes were presented in the field that requires to be market-pulled orientated.

Content analysis coding will be used on the secondary data gathered about the design and development processes, which will be presented in section three of Chapter 5: Results and Discussion on Research Question Two. The title of this study suggests that a design and development process should be identified to implement the necessary packaging evaluation tools. Therefore, the data required about the packaging development processes from more than one of the sources can be used in secondary data analysis. This is linked to research question two.

Chapter 4: Research Design and Methodology

In this chapter, the process of how the research was executed, the type of data required, and the sources of that data are discussed. Chapter 4 is divided into the following five sections:

- Section one is about understanding the seven different categories of this research design and methodology.
- Section two discusses research methods used during identification of the research problem.
- Section three discusses research methods used for research question one.
- Section four discusses research methods used for research question two.
- Section five discusses the research ethics and criticism about the chosen design and methods.

Chapter 1 identified a problem that caused a knowledge gap, resulting in the secondary research questions outlined earlier. The secondary research questions were compiled to leverage the gap between packaging design and development. To be able to understand the reasoning behind the chosen research design and methods, the primary and secondary research questions for this study should be noted:

- The primary research question investigates if there are indications of possible needs for new packaging design and development in order to improve packaging efficiency. This question was derived from the problem statement. The research design and methodology used to reach the problem statement will be discussed in section two.
- Research question one aims to identify a packaging criterion (in terms of packaging efficiency) that may be required to be redesigned or changed for the relevant packaging. This question was derived from the primary research question. The research design and methodology used to approach research question one will be discussed in section three.
- Research question two aims to find the best packaging design or development process necessary to be able to change the criteria identified in question one. This question derived from the primary research question and the research design and methodology used to approach research question two will be discussed in section four.

4.1. Understanding the seven categories to which the two research questions were applied

There are several categories to which research may belong. As depicted in *Figure 4.1*, this study is categorised according to the two research questions. The seven categories are derived from the research onion (Cresswell, 2013; Saunders *et al.*, 2009) and adapted. Each research question had its own unique philosophical paradigm, scientific approach, research strategy, purpose, research design choices, time horizons, data collection techniques, and type of data.

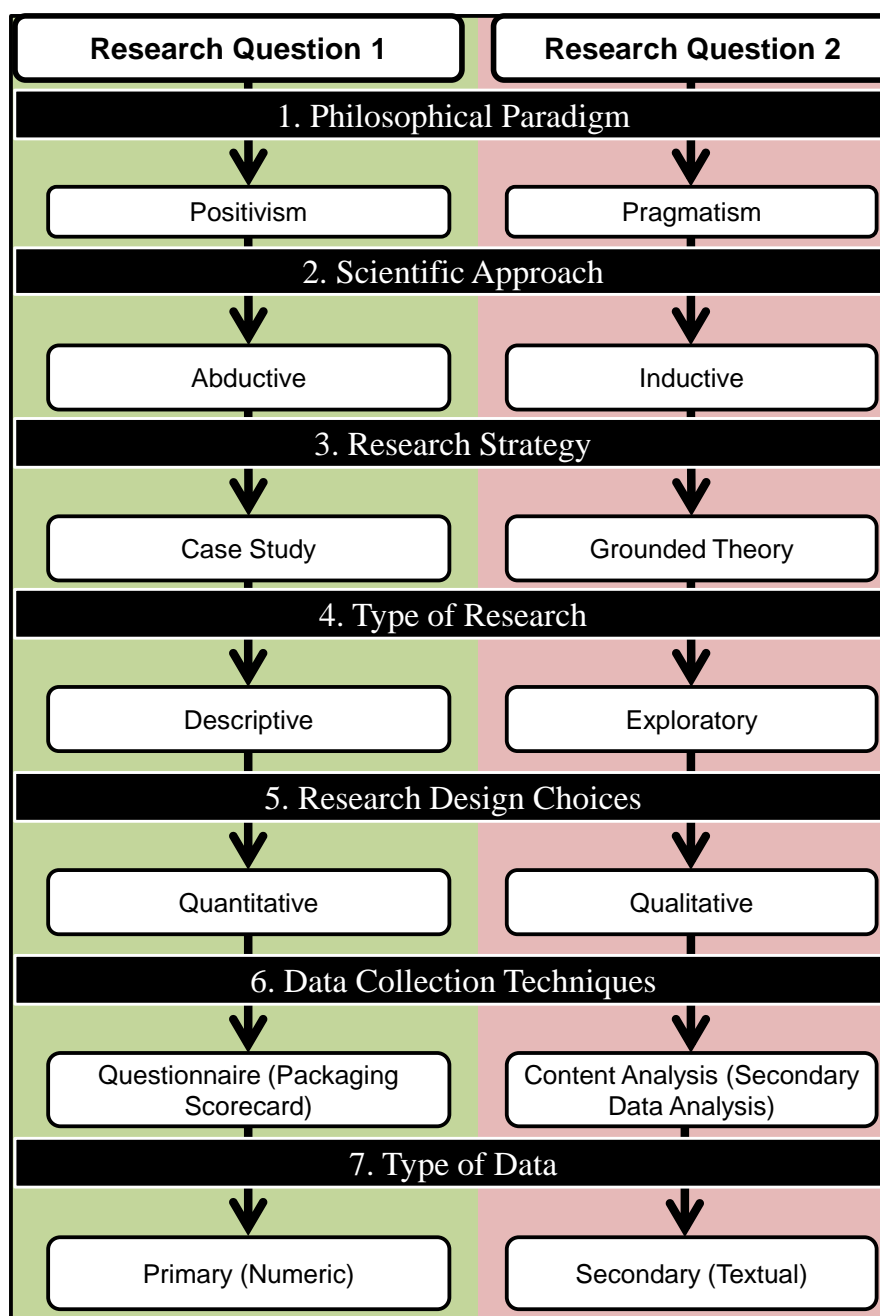


Figure 4.1: Seven categories identified for this research design and methodology.
 Source: Research Onion (Cresswell, 2013; Saunders, *et al.*, 2009)

4.1.1. Philosophical Paradigm or Worldview

The term can be described as “the general philosophical orientation about the world and the nature of research that a researcher brings to a study” (Cresswell, 2013:6). The typical philosophical paradigm of a researcher will sometimes lead to taking on a qualitative, quantitative, or mixed-method approach in the research design (Cresswell, 2013). A research philosophy supports how well a researcher is able to reflect upon their philosophical choices and defend it in relation to any alternatives that could have been used (Saunders *et al.*, 2009).

As seen in *Figure 4.2*, there are two major ways of thinking about the research philosophy, namely ontology and epistemology. If the process of this way of thinking together with the methodology is combined, the research paradigm can be identified.

Ontology, in a philosophical context, is the study of that which exists in general and that which is real (Löfgren, 2013b). In a non-philosophical context, ontology is the study of what exists, but in a specific field (Löfgren, 2013b).

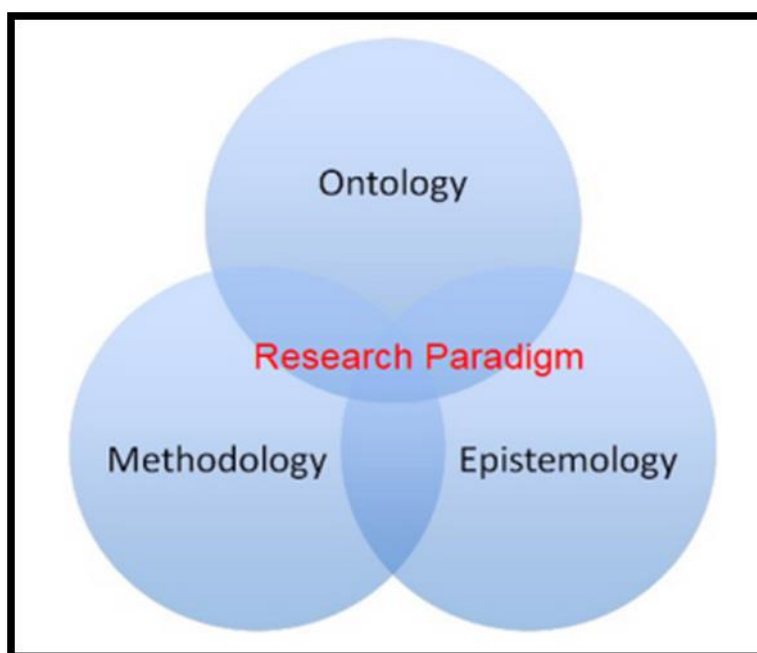


Figure 4.2: Mixing ontology, epistemology, and methodology to find the balanced research paradigm.

Source: (Anderson, n.d.)

Epistemology, in a philosophical context, is the study of knowledge in general (Löfgren, 2013b). In a non-philosophical context, it is the task of producing new knowledge as an academic and discussing its importance (Löfgren, 2013c). Each way of thinking has different outcomes on philosophical paradigms or worldviews. There are many different philosophical

paradigms identified, however the most common are positivism, realism, interpretivism and pragmatism (Cresswell, 2013).

4.1.2. Scientific Approach

The next category is the scientific reasoning behind a research approach. A scientific method can be described as “a sequence of actions that constitutes a strategy to achieve one or more research goals” (Haig, 2010:1326). There are three basic types of scientific reasoning, namely inductive, deductive, and abductive as depicted in *Figure 4.3* (Kovács & Spens, 2005; Moilanen, 2011). The meaning of each reasoning will be discussed as they appear in this chapter.

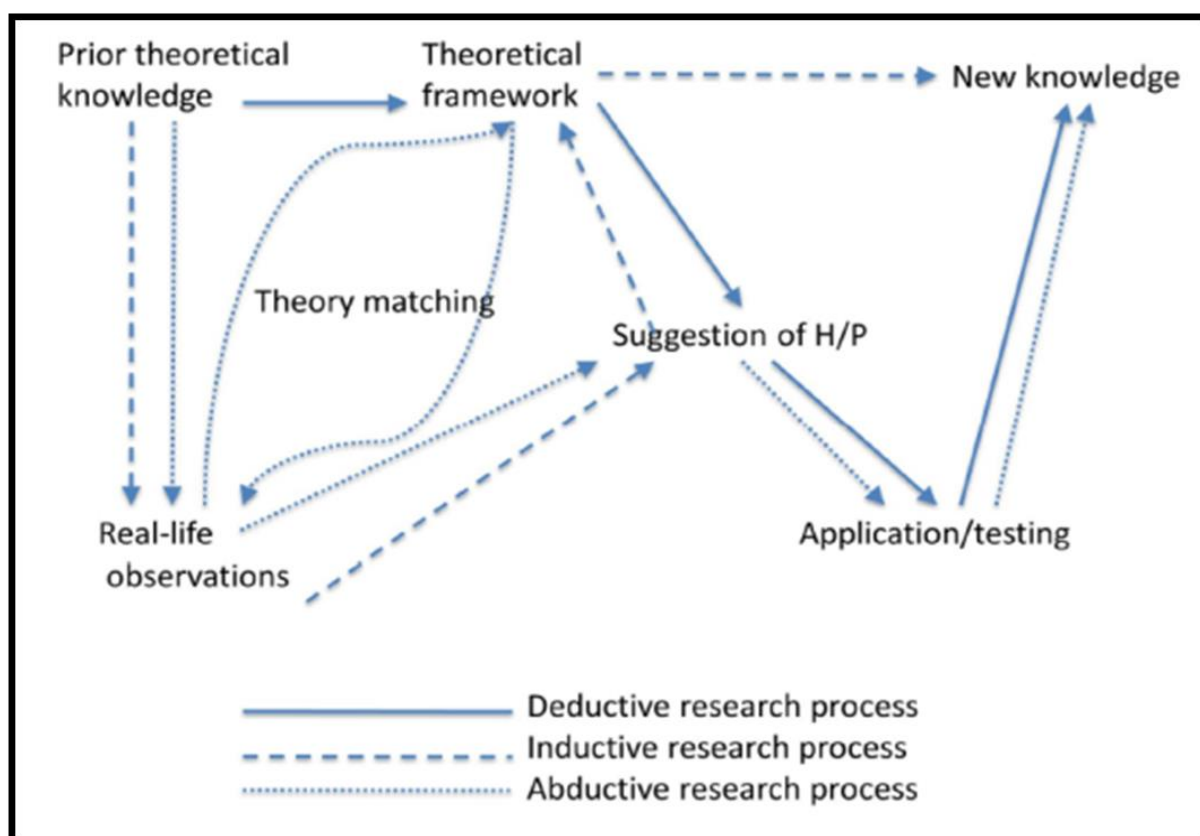


Figure 4.3: Deductive, inductive, and abductive research process (H/P: Hypothesis/Proposition)

Source: (Kovács & Spens, 2005)

4.1.3. Research Strategy

The purpose of this category in a study is “to provide information by which a study’s validity is judged” (Choi & Pak, 2010:800). It should provide enough information to verify whether

the study can be repeated and if readers can identify whether the conclusions are valid (Choi & Pak, 2010). There are various methods to obtain data; however, the most relevant method chosen should represent the research process and goal (Van Wyk, 2012).

4.1.4. Type of Research

According to DeForge (2010), the type of research can be grouped into exploratory, descriptive, explanatory, and evaluative research. Exploratory research and descriptive research observe the relationship between variables and explanatory research and evaluative research measure the causal relationships (DeForge, 2010).

4.1.5. Research Design

One of the most important aspects of research is deciding upon the research design, which is a type of research methodology. A research design is the plan that provides a structure that guides the researcher to address research questions and research objectives (DeForge, 2010).

4.1.6. Time Horizons

According to Saunders *et al.* (2009), the type of time horizon depends on the research question. The researcher should consider whether the study should be researched over a short period or a longer period. Time horizons do not, however, influence the type of research strategy and methods (Saunders *et al.*, 2009).

4.1.7. Data Collection Techniques

Data collection techniques allow the researcher to systematically collect information about the object of the study (people, objects, phenomena) and about the setting in which it occurs (Chaleunvong, 2009). The data collection technique chosen will depend on the variables to be measured, the sources available, and the resources available (Fisheries and Aquaculture Department, 1998). According to Eriksson and Towman (2004) and Saunders *et al.* (2009), there are four concepts that can be used in order to increase the quality of the type of data collected:

- Validity – The data collection technique measures only what it intends to measure.
- Reliability – The data collection technique ensures that the research provides a balanced and decisive outcome.
- Objectivity – This entails to what extent the researcher is affected by non-scientific values.
- Generalisability – This entails to what extent the findings are equally applicable to other research settings.

A researcher can alter or even add data collection methods during a study in order to maintain or keep up with comprehensive results (Eisenhardt, 1989). This is also called triangulation. Triangulation can be used to diversify and/or verify the literature (Sohrabpour *et al.*, 2012).

4.1.8. Type of Data

The type of data to be collected depends on the availability of current data (Chaleunvong, 2009). The data collected can be either primary or secondary and/or in textual or numeric form. If current data is available from the sources, it can be seen as secondary data. Primary data, in turn, is data that is collected for a specific objective and the collection methods can be altered by the researcher (Institute for Work & Health, 2008). Textual data takes the form of words and numeric data is data collected in numbers, which is usually analysed statistically (Saunders *et al.*, 2009).

4.2. Research Design and Methodology for the Problem Statement

The research design and methodology used to derive the problem statement are not categorised as research question one and two. For the online questionnaire and interviews used to support the problem statement, the research strategy, purpose, design, time horizon, data collection techniques, and type of data will be discussed.

4.2.1. Research Strategy

The research strategy for the first phase of the study was a survey. A survey strategy is intended to be used in exploratory or descriptive research. It allows data to be collected from a large population size in an economical way (Saunders *et al.*, 2009). Although surveys can be theory-driven and is good to use in an exploratory survey, they can also be seen as having

a lack of depth and being sample-specific (convenience sampling) (Mouton, 2012). Convenience sampling involves a population that is easiest to obtain data from (Saunders *et al.*, 2009). However, seeing that the purpose of the data to be collected with convenience sampling is for a pilot study to provide indication for the problem statement, which it was for this research, the above-mentioned criticism of convenience sampling is less important (Saunders *et al.*, 2009). This sampling technique is also fast, inexpensive, and easy since the subjects are readily available (Explorable.com, 2009)

4.2.2. Type of Research

This phase of the study is exploratory in nature. An exploratory study is “useful when an understanding of a problem needs to be clarified” (Saunders *et al.*, 2009:170). If exploratory data analysis can be done early on in the study, it can be a good indication whether the research is worth continuing (Perti & Hevey, 2010).

4.2.3. Research Design Choices

The research design for the first phase of this study was a mixed-method approach. Mixed-method research orientation integrates techniques from quantitative and qualitative research and is more applicable to modern research (Pinto, 2010). This approach allows for quantitative and qualitative data collection, analysis, and processes to be applied parallel to each other (Saunders *et al.*, 2009).

4.2.4. Time Horizons

The time horizons can be either cross-sectional or longitudinal. In this phase of the research, the time horizon is cross-sectional. Cross-sectional time horizons are usually implemented in a survey strategy and describe incidents at a specific time (Saunders *et al.*, 2009). The time horizon for this phase of the study occurred at the beginning of the research process and was conducted between March 2013 and November 2013.

4.2.5. Data Collection Techniques and Type of Data

Two data collection techniques were used in this phase. The first technique was an online questionnaire, which produced primary data in numeric form. The second technique entailed interviews, which also produced primary data but in textual form.

a. Questionnaires

A questionnaire is a good tool to use in the beginning of a study (Woods, 2006). Responses to a questionnaire are gathered in a standardised manner, which makes it more objective than interviews (Milne, 1999). The questionnaire can be followed by qualitative techniques that can be used to close various gaps identified by the results of the questionnaire (Woods, 2006).

The online questionnaire for this research was completed using Survey Monkey and Google Docs. The reason was to understand the customers' perspectives on two different fruit juice cartons. The questions were specifically chosen in order to get the participants' perception of the current views on the performance of the carton designs. The two designs were not compared with each other; instead, each respondent had to answer the same question for two different packaging designs. The feedback provided a good indication about whether there is a need for a change to the packaging design. It was a good tool to support the problem statement which was stated at the beginning of this research. The role players were chosen by means of convenient sampling. The participants were mostly located around the Cape Town area in South Africa. The online questionnaire is depicted in *Appendix D: The online questionnaire*.

The answers were based on a 4-point Likert scale. According to Losby and Wetmore (2012), a Likert scale allows respondents to choose an option that best matches their views and attitudes. Respondents can respond to the extent that they agree or disagree with a particular question or statement, which allows the researcher to assess a respondent's attitude about a certain topic (Losby & Wetmore, 2012). This type of scale has a balanced number of positive and negative options (usually 1 to 4) and also does not have a middle value which eliminates the possible misinterpretation of a mid-point by removing the neutral answer option (Losby & Wetmore, 2012). In the online questionnaire, "1" was "fully disagree" and "4" was "fully agree". The sample size (N = 43) was compiled using convenience sampling. The data was collected from 23 August 2013 to 10 November 2013.

b. Interviews

Another technique used in this phase of the study was interviews. According to Eisenhardt and Graebner (2007:28), "Interviews are a highly efficient way to gather rich, empirical data, especially when the phenomenon of interest is highly episodic and infrequent." The interviews for this research were conducted in the form of semi-structured and informal

(unstructured) interviews. There are key differences between the types of interviews and the type of interview method was accordingly chosen which best suited the type of data required or the situation in which the interview was conducted.

The goal of a semi-structured interview is to gain structured information from the sources while maintaining an open conversation in order to obtain a wider perspective from the expertise of the interviewee (Bramklev, 2007; Sohrabpour *et al.*, 2012). The semi-structured questions were conducted using the critical thinking method, which is a method of obtaining facts from experts or less experienced users of the existing system to gain knowledge of the field (Flanagan, 1954; Sohrabpour *et al.*, 2012). Some of the questions were repeated with various stakeholders. This helped in gaining perspective from different stakeholders while identifying the different views of each individual stakeholder.

Informal (unstructured) interviews give the researcher the ability to have conversations with the interviewees and therefore generate questions in response to the interviewees' answers (Zhang & Barbara, 2009). An informal interview is "best used in the early stages of the development of an area of inquiry, where there is little literature describing the research problem in question" (Robert Wood Johnson Foundation, 2008). Therefore, this was a good step to obtain relevant literature in the packaging logistics and supply chain integration, packaging development and packaging analysis fields. The goal of the informal interview was to obtain in-depth understanding of particular research goals that were not yet fully understood or clear to the researcher/interviewer (Zhang & Barbara, 2009).

The interviews were conducted with leading experts and academics in the packaging field in Sweden and South Africa over the period of June 2013 to January 2014. The details of the interviews are depicted in *Table 4.1*. The structured interview with the product manufacturer is depicted in *Appendix G: Structured Interview Questions with the Product Manufacturer*. This was useful in collecting relevant information based on the following topics: the packaging development process, packaging evaluation, and the specific packaging relevant to this research (the 1-litre aseptic carton used in the fruit juice industry).

According to Bogner *et al.* (2009), having an interview with experts in the fields is an efficient and direct approach of gathering data. Furthermore, it is also a good tool to use in order to gain access to knowledge in a particular field which are not easy to come by (Bogner, *et al.*, 2009). The experts were chosen based on their positions in the field they work

in and the supply chain position the company is located in (e.g. supplier, customer, and consumer).

Table 4.1: Key role players interviewed for this research.

Time Frame	Role	Interviewee	Supply Chain Position	Demographic	Type of Interview	Title of interview
September 2013	Packaging Expert	Product Manufacturer	Product Manufacturer	Cape Town, South Africa	Semi-structured	Packaging Development Process
November 2013	Academic	Lecturers and Researchers	Research	Lund, Sweden	Informal	Packaging Development Process
December 2013	Packaging Expert	Packaging Manufacturer	Packaging Manufacturer	Lund, Sweden	Semi-structured	Packaging Development Process

The academics were a good source of the most recent stages and developments in the design and development of packaging in the logistics environment. The academics were helpful in guiding the research towards a goal. It was a good method to gain access to up-to-date literature about the packaging logistics field.

The packaging manufacturer interviewed for this research was a good source of information regarding the research problem. The reason is because the packaging manufacturer has no business or decision-making power in the choice of secondary packaging, but rather in primary packaging (Sohrabpour *et al.*, 2012). The interviewee was one of the oldest designers for this packaging manufacturer and has a patented design, which is still used in the South African market today. The interviewee provided vital packaging design and development information and guidance. This interview was vital in identifying the key role players in the packaging design and development process.

The product manufacturer interviewed for this research adopts a unique packaging development process, which is different from the packaging manufacturer's process. It was therefore beneficial to gain knowledge about the packaging development process from a product manufacturer's point of view. The interviewee was a good source in clarifying the partnership between product manufacturers and packaging manufacturers in the packaging development field. A second product manufacturer was very hard to gain access to for an interview; therefore only one product manufacturer was interviewed.

4.3. Research Methods for Research Question 1

4.3.1. Philosophical Paradigm

The philosophical paradigm in phase two of this research, which was used to address research question one, was a positivist worldview. The positivist researcher can do little regarding the data collection in the sense that there is not much that can be done regarding the information gathered (Saunders *et al.*, 2009). A positivist worldview is based on observing and measuring the reality while assessing the cause of outcomes from experiments, in this case stemming from the packaging scorecard (Cresswell, 2013).

4.3.2. Scientific Approach

The scientific method for the first phase of the study was more deductive than inductive, which can be identified as an abductive approach (Sohrabpour *et al.*, 2012). An abductive approach “is about investigating the relationship between everyday language and concepts” (Dubois & Gadde, 2002:555), which ultimately leads to new insights from a current development to a new perspective (Sohrabpour, 2012). The results from the data collected from the packaging scorecard may therefore give new insights into packaging design and development.

4.3.3. Research Strategy

The research strategy for this part of the second phase of the study was a case study. Case studies allow researchers to explore the uniqueness of an event while learning about the entities involved (Putney, 2010). Furthermore, case studies can be used for more than one unit of analysis, which can be beneficial when it is necessary to compare two or more phenomena (Saunders *et al.*, 2009). To obtain the goal set out in research question one, a collective case study was chosen to identify the rationale of this research. The case study design chosen for this research is a multiple (comparative) case study design with the purpose of being exploratory.

The objective of a collective case study is to have more than one case to evaluate the differences between them (Putney, 2010). Therefore, a multiple case study design allows comparing cases holistically and studying various units within identifiable cases, which can be seen as repeated experiments (Eisenhardt, 1989; South-East European Research Centre,

2010). Multiple case study research design enables the researcher to draw cross-case conclusions based on theory (South-East European Research Centre, 2010). Furthermore, it explores differences within and between cases so that comparisons can be drawn in terms of the variables (Baxter & Jack, 2008).

The variables, in this research, are the packaging criteria and the different packaging designs. Single case study designs are to be implemented only when the aim of the research is to determine the accuracy of an already established reasoning or theory (Casell, 2011) and when there is no need for comparing cases (Yin, 2003). When conducting a case study, it is important to assess the generalisation concept to determine whether the findings can be valid for other situations (Eriksson & Towman, 2004). Because of the latter, cases can be concluded in terms of a theory, either from literature or data (Putney, 2010). Finally, exploratory case studies are intended to explore what can be learned from the research problem (Putney, 2010). This enables the researcher to propose further research within the relevant field (Putney, 2010). Case studies enable researchers to gather both quantitative and qualitative data (Putney, 2010). The data were gathered by means of the packaging scorecard.

The packaging scorecards were completed by retailers and consumers located in Cape Town, South Africa. The numeric data collected from the questionnaires were analysed in Tableau (a computer software programme) for the different carton designs. For each supply chain actor mentioned above (retailer or consumer), the packaging scorecard was adjusted in order to make the scoring process convenient. The packaging scorecard adjusted for each supply chain actor can be seen in *Appendix E: Adjusted Packaging Scorecard for the Six Different Packaging Designs completed by Retailers*, for the retailers and *Appendix F: Adjusted Packaging Scorecard for the Seven Different Packaging Designs completed by the Consumers*.

Retailers: Four different retailers were identified, based on a convenience sample's size. The managers or inventory controllers were asked to complete a packaging scorecard based on the primary packaging they distribute in their store. An example of each primary packaging design was displayed in order to ensure real-life interaction with the packaging design.

Consumers: Respondents from the online questionnaire were approached and asked to participate in the evaluation of different packaging designs. The respondents completed the packaging scorecard from a consumer's point of view. An example of each primary

packaging design was displayed in order to ensure real-life interaction with the packaging design.

Three case studies, namely case study A, B and C, were conducted during this research. The results were obtained from the packaging scorecard and were then analysed and visually presented using Tableau.

a. Case Study A

The first case study represents one product manufacturer that is making use of two different primary packaging design types. The packaging designs were numbered as Packaging Design #1 and Packaging Design #5. The units of analysis are the results from the packaging scorecard. The sub-units for this research are the two primary packaging designs, because both primary packaging cartons have the same volume and are from the same packaging manufacturer, but with different carton designs and different spout designs.

b. Case Study B

The second case study represents one product manufacturer that is making use of two different primary packaging design types. The packaging designs were numbered as Packaging Design #2 and Packaging Design #4. The units of analysis are the results from the packaging scorecard. The sub-units for this research are the two primary packaging designs, because both primary packaging cartons have the same volume and are from the same packaging manufacturer, but with different carton designs and different spout designs.

c. Case Study C

The third case study represents more than one product manufacturer that are making use of three different primary packaging design types. The packaging designs were numbered as Packaging Design #3, Packaging Design #6, and Packaging Design #7. Packaging design number seven was analysed by the consumers, but not the retailers. The units of analysis are the results from the packaging scorecard. The sub-units for this research are the three primary packaging designs, because all the primary packaging cartons have the same volume, but with different carton designs and different spout designs.

4.3.4. Type of Research

This phase of the study is descriptive in nature. Descriptive research needs to “produce an accurate representation of persons, events or situations” (Saunders *et al.*, 2009:590). Descriptive research is a good tool to answer the “what” question (Saunders *et al.*, 2009). Research question one aims to identify what the packaging criteria are that contribute to a packaging design that performs poorly.

4.3.5. Research Design Choices

The research design for the first phase of this study was a quantitative approach. Quantitative research “produces results that can be used to describe or note numerical changes in measurable characteristics of a population of interest; generalize to other, similar situations; provide explanations of predictions; and explain causal relationships” (Kraska, 2010:1167). The packaging scorecard produces numerical results, which can be analysed using various techniques (Dominic & Olsmats, 2001).

4.3.6. Time Horizons

The time horizons depicted for this phase of the research are cross-sectional. The data collection period for the packaging scorecard was June 2015 to September 2015.

4.3.7. Data Collection Techniques and Type of Data

The data collection technique used to gather the relevant data required for research question one took the form of a structured questionnaire form. The questionnaire consisted of the packaging scorecard. The packaging scorecard is the evaluation model that is able to identify the performance of packaging criteria (Pålsson, 2013), hence contributing towards compiling the problem statement and filling the gap identified in research question one. The type of data gathered from a packaging scorecard is primary and numeric. A data visualisation program, called Tableau, was used to analyse and visually present the results from the packaging scorecards. Tableau offers an efficient way to process and interactively visualise large data sets (Wesley *et al.*, 2011).

4.4. Research Methods for Question 2

4.4.1. Philosophical Paradigm

The philosophical paradigm for phase two and research question two of this study was pragmatism. According to Saunders, *et al.* (2009), a pragmatic worldview enables the researcher to view the study with variations of epistemology, ontology, and axiology. A pragmatic worldview accepts an idea as true, only if it can be practically implemented in the field. It can be argued that the intended design and development process is only theoretically developed during this research. However, approaching it as a pragmatic philosophical paradigm, it will enable the researcher to think practically rather than theoretically about the design and development process (Saunders, *et al.*, 2009). This will allow any unpractical ideas to be rejected. Pragmatism focuses on the research problem and allows the researcher to adopt mixed methods to gain knowledge about the problem (Cresswell, 2013). Although pragmatism mostly makes use of mixed methods, this section only used a qualitative design. The researcher can adopt objective and subjective points of view, which assist in choosing the best way to answer a research question (Saunders *et al.*, 2009).

4.4.2. Scientific Approach

The scientific method for research question two of this research was an inductive approach. In inductive logic “observations about the world will lead to emerging propositions” (Kovács & Spens, 2005 cited in Sohrabpour, 2012). An inductive approach enables the researcher to collect data and develop a theory because of the data that leads to identifying the research questions or hypotheses (Saunders *et al.*, 2009).

4.4.3. Research Strategy

The research strategy for this phase tends towards a grounded theory strategy, but is in actual fact content analysis coding for qualitative research. A grounded theory according to Strauss and Corbin (1998 cited in Bryman *et al.*, 2014:345), is a “theory that was derived from data, which is systematically gathered and analysed through the research process. In this method, data collection, analysis, and eventual theory stand in close relationship to one another.” However, the research questions and literature review support conceptual thinking and theory building rather than empirical testing of the theory (Khan, 2014). Therefore, since the

theoretical packaging development process will be structured using mostly existing data in the field, the research strategy will be qualitative content analysis. Grounded theory has four different tools: theoretical sampling, coding, theoretical saturation, and constant comparison. Coding will be used not based on the grounded theory, but in terms of qualitative research.

4.4.4. Type of Research

This phase of the study is exploratory in nature. Exploratory research takes the form of a new angle, which is a new way of looking at things, either from a theoretical perspective or a new way of measuring something (Saunders *et al.*, 2009). This allows the researcher to understand the data in detail and identify patterns in which the data are analysed (Perti & Hevey, 2010).

4.4.5. Research Design Choices

The research design for the first phase of this study was a qualitative approach. Qualitative research can be used to collect or analyse non-numerical data (Saunders *et al.*, 2009). It enables the researcher to filter every observation and interpretation, which brings value and personal identity to the process (Staller, 2010).

4.4.6. Time Horizons

The time horizon for this phase of the research is cross-sectional. The data collection period for this phase of the research occurred at the start of the study in 2013. At the end of the research, in October 2015, the content analysis coding was completed.

4.4.7. Data Collection Techniques and Type of Data

The data collection technique for phase two and research question two of this study was content analysis. Content analysis allows the researcher to analyse content of texts in the form of words, meanings, pictures, symbols, or themes (Mouton, 2012). Content analysis is a non-reactive and flexible method that can be applied to structured and unstructured information sources (Bryman *et al.*, 2014). Content analysis can mostly be applied to secondary data (Saunders *et al.*, 2009). Therefore, secondary data in textual form was obtained, which was relevant to packaging design and development processes. There are six steps to conduct content analysis and coding that have been identified by Löfgren (2013) and Bryman *et al.* (2014):

Step 1: Transcribe the data that was obtained from structured interviews and secondary data (as seen in *Appendix I*). Three methods were used to find the relevant secondary data in textual form.

Firstly, data was located by making use of Google Search Engine and Google Scholar and identifying reports, articles, and papers. Google is a great modern tool to obtain relevant information, but only when used the correct way (Littlefield, n.d.). In the search field of the search engine, the researcher used quotation marks (“ ”) for more specific results. An asterisk (*) was used to replace a word with other common terms and retrieve it with multiple endings. A tilde (~) was used to search for related words that follow after the tilde. Finally, a hyphen (-) was used to exclude any words from the search (University of Victoria, 2015). For example, if a report on the different air speed velocities of common swallows are required, it can be searched as follows: *filetype:pdf air speed entitle:velocity of *swallows*. Or if you are looking for articles in the New York Times about test scores in college, but not SAT’s, written between 2008 and 2010, it will be: *site:nytimes.com ~college “test scores” –SATs 2008..2010*. If you are looking for papers, for example, about photosynthesis by Dr. Ronald L. Green and Dr. Thomas P. Buttz, search for: *author:green photosynthesis “tp buttz”*.

Furthermore, the Stellenbosch University Library Database, the Lund University online publications and library database, as well as the free scholarly database called JSTOR were used to search for “e-journals” and/or online publications. Abstracts were scanned in order to look for the relevant descriptions of the packaging development process. If the relevant descriptions fitted the research objectives, the source was used as supporting references to any claims or processes linked to packaging development. Publications on packaging, packaging evaluations, packaging development processes, packaging efficiency, and packaging design were mainly used to locate useful references.

Secondly, literature from the Packaging Logistics course, presented by Stellenbosch University and Lund University, was used to obtain the necessary information and tools to support this research. The latter research institutes have collaborations within the logistics field through packaging logistics. This provided the opportunity to correspond with some lecturers and researchers in the field of packaging.

Finally, relevant information that could be gathered from publications in the local newspaper, videos posted online through YouTube or TetraPak’s website, interviews from local radio

stations, and data from conferences was obtained. The latter literature was obtained by making recordings and/or notes.

After obtaining all the above-mentioned data in step one, the transcription process was completed. Next, there were three stages to analyse data in order to complete step one of the content analysis. According to Bryman *et al.* (2014), these stages are:

- Data Reduction that entails reducing data into manageable sizes using open, axial, and selective coding to decide which data is important. Microsoft Excel was used during this phase.
- Displaying Data entails providing a visual overview of the data using diagrams such as network, Venn, radial, or cycle diagrams. A network diagram was used to display the data.
- Drawing conclusions and verifying data entail increasing the validity and reliability of data. Moreover, data sources and collection can be improved by making use of triangulation. Therefore, as mentioned earlier, the data was obtained through interviews and secondary data analysis.

Step 2: Label the relevant pieces through coding. Coding is the process of interpreting secondary data and representing it in a different way in keeping with the objectives of the research (Bryman *et al.*, 2014). The relevant pieces will be key words or phrases that are repeated in several ways (Löfgren, 2013). These words or phrases were relevant to packaging design and development processes.

Step 3: Categorise the groups identified in step two and group them. This was done in Microsoft Excel and can be seen in *Appendix I: First Phase Results of the Content Analysis Coding*.

Step 4: Label categories and describe the connection between them. This allowed understanding the significant differences between the perceptions of packaging development by the author. It was a good way to identify differences in terminology for the same meaning.

Step 5: Assign the categories to their respective positions in the hierarchy. This assisted in distinguishing the order of processes. Some processes have to happen before others. This step assisted in creating the sensible order in which each process should take place.

Step 6: Write up the results. The results and the discussions are written up in Results and Discussions.

4.5. Research Ethics and Criticism of the Research Design and Methodology

This section considers some of the hurdles that were encountered during the course of this research. It includes hurdles regarding ethics, confidentiality, and criticism of the chosen designs and methods.

Each participant of the packaging scorecard was given a letter of consent (see *Appendix H: Letter of Consent for the Information gathered from the Key Role Players*) that had to be approved by the participants. All the interviews were recorded as per consent from the interviewee. If permission was not given, notes were made by the interviewer. One of the product manufacturers was difficult to get hold of and book an interview. It might have been because of confidentiality issues. Furthermore, it can be argued that the information gained from only one product manufacturer is biased and not reliable. However, the information required from product manufacturers had no influence on the research results from the online questionnaire, no influence on the packaging evaluation tool, and no direct influence on the content analysis. Even though Olsmats and Dominic (2003) argue that data for the packaging scorecard may be gathered from product manufacturers, it was not done for this research. In this study, the product manufacturers were left out for two reasons. Firstly, the results for research question one are divided into three case studies, each representing different product manufacturers. Secondly, the aim was to avoid biased answers that would favour the packaging designs represented by certain product manufacturers in each case study.

This methodology is not guaranteed to improve packaging efficiency of packaging systems. However, since this research manages to identify criteria in terms of their importance and performance from the perspectives of different actors in the supply chain, it provides quantitative proof from each case study that packaging designers can use when considering new packaging design and development. This is specifically true for the packaging solutions considered in this research. Therefore, the results of research question two can only be seen as a theoretical proposal with a practical philosophical approach. Hence the research strategy for research question two tending towards grounded theory, but was conducted using secondary data analysis through content analysis coding.

The proposed packaging development process is also not guaranteed to be more efficient than packaging development processes that are already in use. However, studying and combining methods from different literature sources and current systems is a good way of understanding and even building new models when necessary in the future (Branklev, 2007; Rundh, 2005).

Chapter 5: Results and Discussions

Each section in this chapter represents the results and discussion acquired from the packaging scorecard and the literature from the packaging development processes in Chapter 3. Section one will discuss the results from the packaging scorecard and the results for research question one. Section two will portray content analysis by combining the literature gathered in Chapter 3 and discussing the results for research question two. Finally, section three will bring the two sections together and explain how they fit together. The results for research question two are dependent on the results from research question one.

5.1. Results and Discussion on Research Question One

Research question one:

By making use of a certain packaging evaluation model, which packaging criteria (that affect packaging efficiency) should be improved by analysing different aseptic carton designs in the South African market?

The packaging evaluation model chosen for this research was the packaging scorecard, since it evaluates criteria that affect packaging efficiency. The packaging scorecard was able to fill the gaps created by research question one and provided guidance towards answering research question one. The packaging scorecard has a wider scope than the PIQET. Both the packaging scorecard and the PIQET evaluate packaging criteria, which are required for this research. However, the packaging scorecard takes into account the practical aspects and other parts of the distribution chain (Svanes *et al.*, 2010).

Results were collected from the packaging scorecards and are illustrated in the three different case studies. In total there are seven different 1-litre carton designs, six that are used in the fruit juice industry in South Africa and one that is not used in South Africa. Each case study can further be divided into two different supply chain actors, namely retailers and consumers.

The retailers were given 6 different packaging designs and were asked to evaluate the packaging design by making use of the packaging scorecard. The consumers were given seven different designs and were asked to evaluate the packaging design using the packaging scorecard. The reason to include the seventh packaging design with the consumers'

evaluation were to identify whether that specific packaging can compete in the South African market when considering it from a consumer's perspective. It can also be seen as the "new" packaging design that can be considered. The reason this specific design was chosen is because some of the characteristics of the design are the same as the other carton designs.

The scores gathered from the packaging scorecard were calculated by average and not median. The total scores shown as median provided similar results to the total scores represented in average. Since the data provided was ordinal (between 1 and 4), the median scores provided scores that were mostly rounded resulting in answers that were ambiguous and very similar. Using an average score in turn provided results to at least three decimal points. This was useful seeing that the results could then be compared more efficiently. The sample size for the packaging scorecard was 22 participants. Four of these were retailers and eighteen consumers. The data resulted in 1,752 Excel data entries, which were analysed in Tableau. All the raw data is available with the author. The variables used for these fields are depicted in *Table 5.1*.

Table 5.1: Variables used in the results from the packaging scorecard.

Variable	Meaning
Case#	Case number A, B or C
Case# WTotal	Weighted Total scores for each Case
Actor	Actors in the supply chain, either the retailers or the consumers
Actor (weighted total)	Weighted scores for each retailer
Criteria	Packaging criteria analysed for this research
Design	Packaging design according to its number (example score#1)
Design WTotal	Weighted total for each design according to its number (example TotalW Score#1)

Both the normal scores and weighted scores were calculated since each provided different results. The results for research question one are divided into five sections. The first three sections will discuss the results from each case study. Section four will discuss the combined results from all the case studies. Finally, the fifth section will provide a summary of all the results gathered for research question one. The following results were obtained from the packaging scorecards. The four sections (listed from a to d) of each case study as well as the combined results will provide and discuss the following:

- **Weight per criteria** entails identifying the most important packaging criteria.
- **Score per criteria broken down by design** entails identifying criteria on which each design scores well or poorly.

- **Total weighted score per design broken down by actor** entails comparing designs and identifying the best or worst design.
- **Scores per criteria** entail identifying criteria on which all packaging designs in a given case performs well or poorly.
- **Final discussions** entail discussing the results stemming from the case study and proposing a plausible opinion when moving towards research question two.

5.1.1. Case Study A

The product manufacturer represented in case study A uses two different carton designs and two different spout designs. Packaging Design #1 and Packaging Design #5 can be seen in *Figure 5.1*.

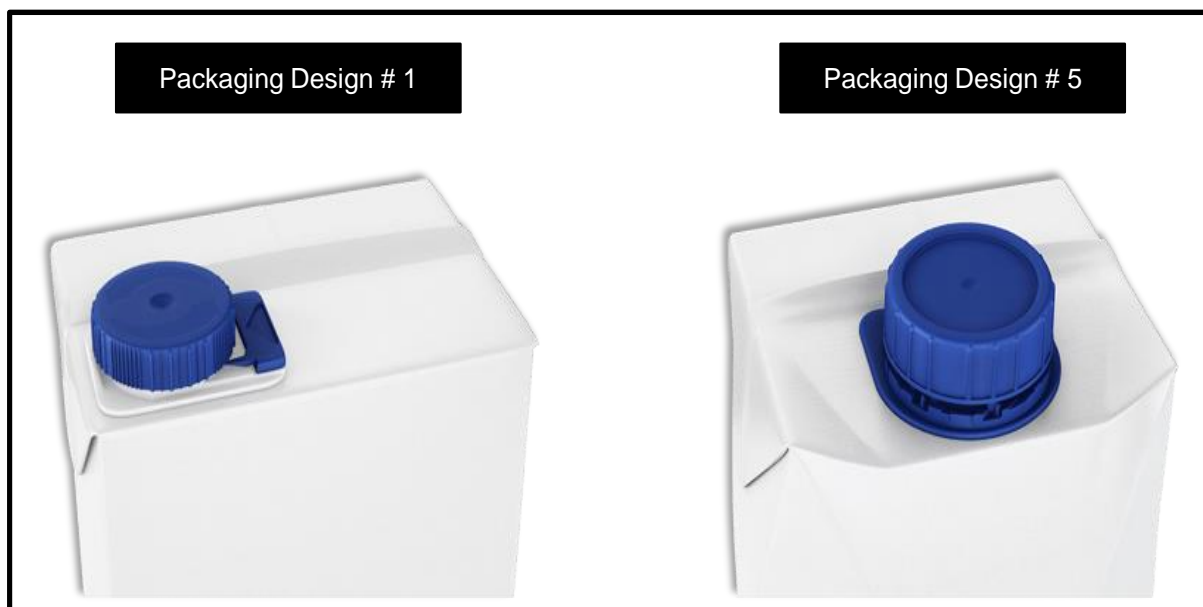


Figure 5.1: The two packaging designs used in Case Study A.

Source: (Tetra Pak, 2013)

a. Weight of each criterion

A combined criteria score for Case Study A is illustrated in *Figure 5.2*. This graph depicts the most important packaging criteria for the packaging designs in Case Study A. It was rated where “0” means not relevant and “100” means very important.

The top five important packaging criteria identified for the two designs in Case Study A are flow information, safety, volume and weight efficiency, product protection, and the spout design. Therefore, when considering design changes, it could be beneficial to emphasise focus on the latter criteria. Hence, a score for each criterion is required.

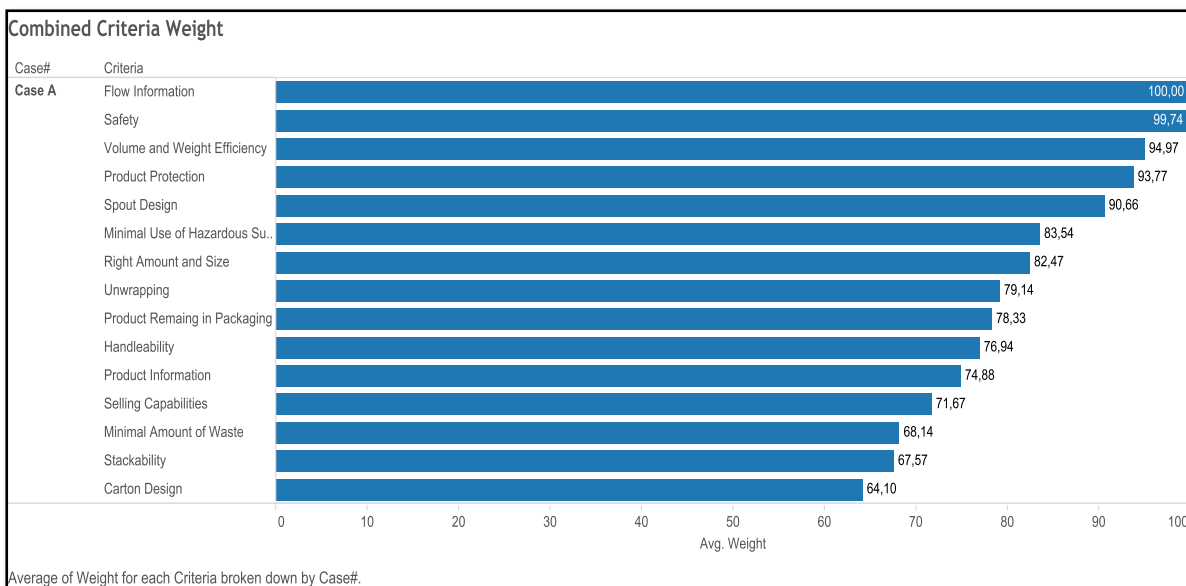


Figure 5.2: Weight for each criterion in Case Study A.

b. Score for each criterion broken down by design

Non-weighted scores (depicted in the graphs below) means that the score amount is not a weighted score. Non-weighted scores provide the score of each design or criterion regardless of the weight according to its performance. Each packaging design was evaluated according to its packaging performance where ‘1’ is not approved and ‘4’ is approved. The combined results from the retailers and consumers are shown in *Figure 5.3*.

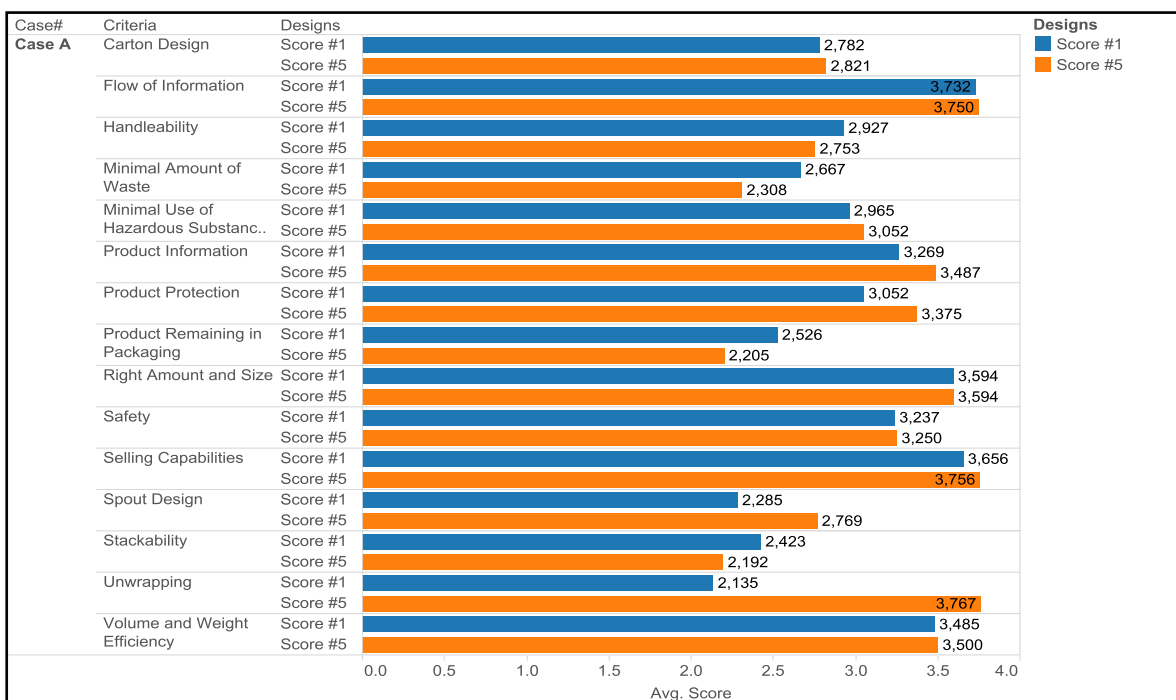


Figure 5.3: Average score per packaging criterion from the two packaging designs in Case Study A.

The results illustrate the score of each packaging design received from both the supply chain actors. The scores for each criterion are broken down in terms of the two designs. Packaging design #1 is shown in blue and packaging design #5 is shown in orange.

Packaging design #5 has higher scores than packaging design #1. The scorecard results of Case Study A are compared in *Table 5.2* where the scores for each packaging design are sorted from highest to lowest. The three highest scoring criteria for packaging design #1 are flow information (3.732), selling capabilities (3.656), and right amount and size (3.594). The three lowest scoring criteria are unwrapping (2.135), spout design (2.285), and stackability (2.423).

Table 5.2: Packaging criteria's average scores ranked from highest to lowest for the two designs in Case Study A.

	Criteria	Packaging Design #1
1	Flow Information	3.732
2	Selling Capabilities	3.656
3	Right Amount and Size	3.594
4	Volume and Weight Efficiency	3.485
5	Product Information	3.269
6	Safety	3.237
7	Product Protection	3.052
8	Minimal Use of hazardous Substances	2.965
9	Handleability	2.927
10	Carton Design	2.782
11	Minimal Amount of Waste	2.667
12	Product Remaining in Packaging	2.526
13	Stackability	2.423
14	Spout Design	2.285
15	Unwrapping	2.135

	Criteria	Packaging Design #5
1	Unwrapping	3.767
2	Selling Capabilities	3.756
3	Flow of Information	3.750
4	Right Amount and Size	3.594
5	Volume and Weight Efficiency	3.500
6	Product Information	3.487
7	Product Protection	3.375
8	Safety	3.250
9	Minimal Use of hazardous Substances	3.052
10	Carton Design	2.821
11	Spout Design	2.769
12	Handleability	2.753
13	Minimal Amount of Waste	2.308
14	Product Remaining in Packaging	2.205
15	Stackability	2.192

The highest scoring criteria for packaging design #5 are unwrapping (3.767), selling capabilities (3.756), and flow information (3.750). The three lowest scoring criteria are stackability (2.192), product remaining in packaging (2.205), and minimal amount of waste (2.308).

In order to indicate which packaging design is the overall best or worst, a combined total weighted score per design can be depicted. This depiction will show combined results from the graph above.

c. Total weighted score per design broken down by actor

The weighted scores per design are depicted in *Figure 5.4* for the retailers, *Figure 5.5* for the consumers and *Figure 5.6* as a combination.

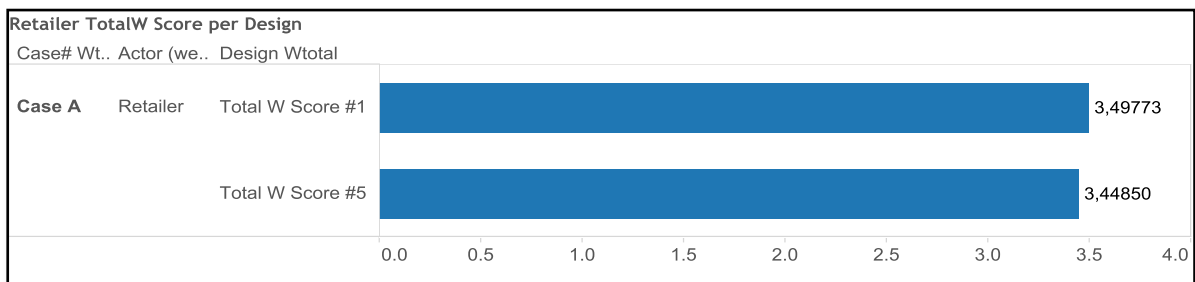


Figure 5.4: Total weighted score given by retailers for each design in Case Study A.

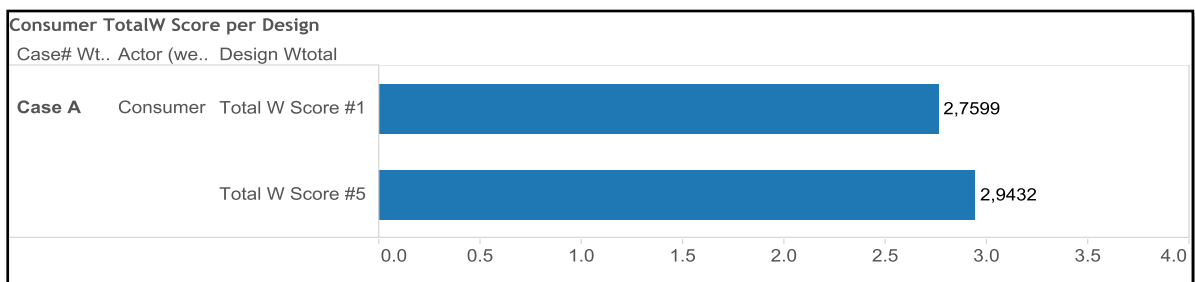


Figure 5.5: Total weighted score given by consumers for each design in Case Study A.

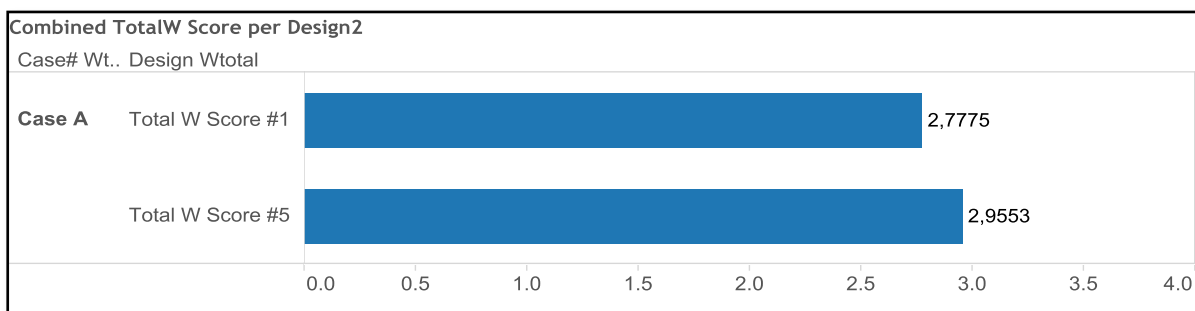


Figure 5.6: Combined total weighted score for each design in Case Study A.

Results from the retailers show that packaging design #1 has a weighted score of 3.498 and packaging design #5 has a weighted score of 3.449. Results from the consumers show that packaging design #1 has a weighted score of 2.760 and packaging design #5 has a weighted score of 2.943. Combined results show that packaging design #1 has a weighted score of 2.778 and packaging design #5 has a weighted score of 2.955

These results indicate that, according to the participating consumers and retailers, packaging design #5 is a better packaging design according to the packaging criteria listed in the packaging scorecard. Hence, if design changes are considered, they should be considered for packaging design #1. Furthermore, in order to indicate which packaging criteria are the best overall, a combined score per criteria can be depicted.

d. Score per criterion

Finally, in order to identify the criteria scoring well or poorly, which may be useful to know for packaging design and development improvements, one more graph is necessary. This bar graph, showing the combined weighted score per criterion, can be seen in *Figure 5.7*. By looking at this graph, it can be easily determined which packaging criteria scored the lowest in the combination of designs in case study A.

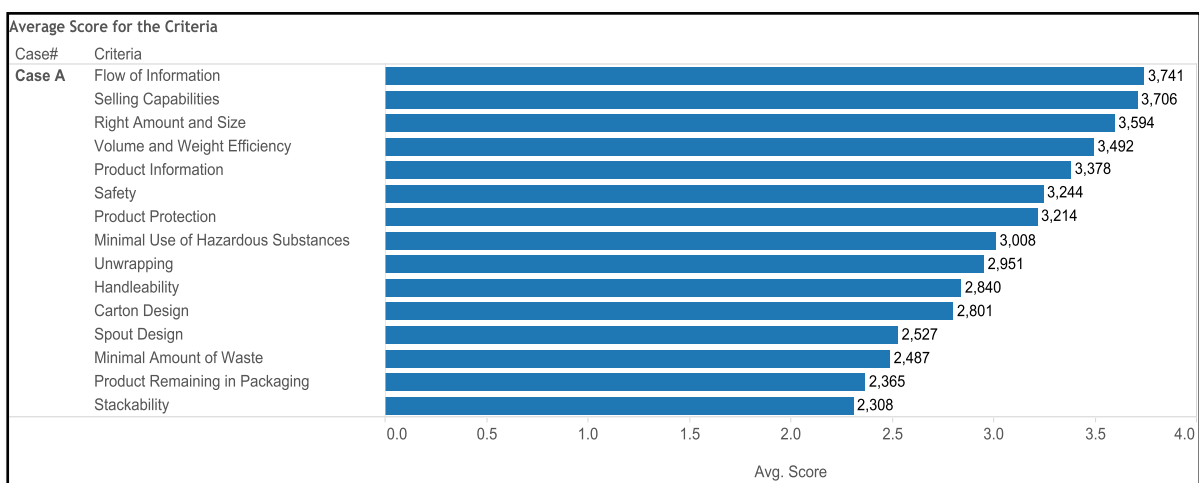


Figure 5.7: Average score for the criteria in Case Study A.

The three criteria scoring the highest are flow of information (3.741), selling capabilities (3.706), and right amount and size (3.594).

The three criteria scoring the lowest are stackability (2.308), product remaining in packaging (2.365), and minimal amount of waste (2.487).

e. Final discussion

According to the participating retailers and consumers, packaging design #5 is a better packaging design when compared to packaging design #1. The following can be considered when approaching the redesign or development process of a new packaging design in terms of research question two:

Firstly, the best criterion for packaging design #5 is unwrapping. The worst criterion for packaging design #1 is also unwrapping. For the consumers, unwrapping affects the type of spout design. The spout design on packaging design #5 breaks a seal when opened for the first time. This reduces the unwrapping process, which results in unwrapping receiving a higher score. However, the criterion called product remaining in packaging also affects the spout design. This means that although packaging design #5 scored high in unwrapping, the product remaining in packaging score is low. Therefore, if one considers redesigning packaging design #1, a similar unwrapping concept as in design #5 could be used. However, changes to the spout design should also be considered since it is also the second worst scoring criterion for packaging design #1.

Secondly, the criterion scoring the lowest in case study A is stackability. Stackability affects the logistics efficiency for product and packaging manufacturers, the marketing ability at retailers and satisfaction from a consumer's perspective (Pålsson, 2012). Furthermore, different kinds of spout designs affect the stackability of some packaging designs (Björck, 2013; Volmink, 2013). Stackability as well as the spout design for packaging designs #1 and #5 can therefore be considered to be redesigned or improved through a packaging design and development process.

5.1.2. Case Study B

The product manufacturer represented in Case Study B uses two different carton designs and two different spout designs. Packaging Design #2 and Packaging Design #4 can be seen in *Figure 5.8*.



Figure 5.8: The two packaging designs in Case Study B.

a. Weight of each criterion

A combined criteria score for Case Study B is illustrated in *Figure 5.9*. The top five important packaging criteria identified for the two designs in Case Study B are flow of information, safety, volume and weight efficiency, product protection, and the spout design. Therefore, when considering design changes, it could be beneficial to emphasise focus on the latter criteria. Hence, a score for each criterion is required.

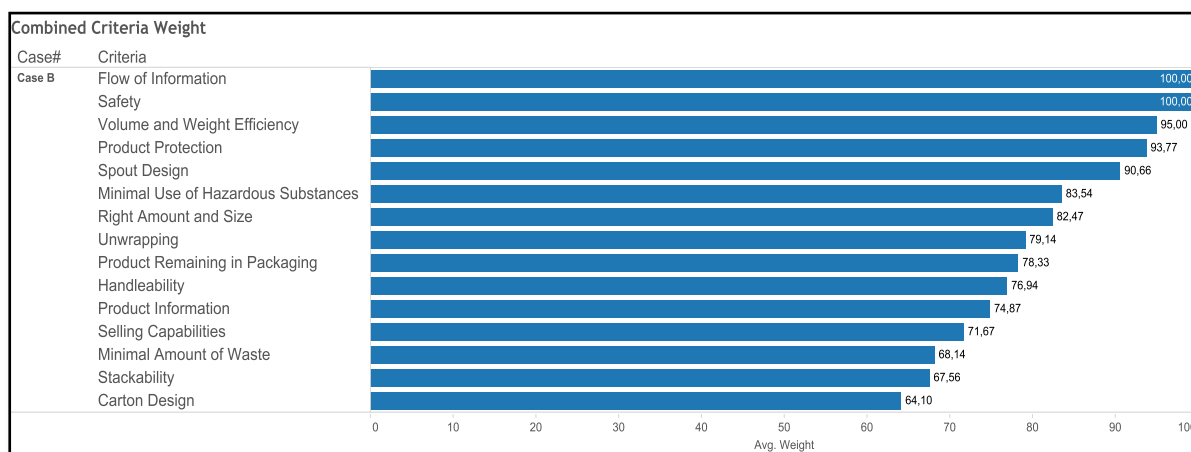


Figure 5.9: Weight for each criterion in Case Study B.

b. Score for each criterion broken down by design

The combined results from the retailers and consumers are shown in *Figure 5.10*. The scores for each criterion are broken down by terms of the two designs.

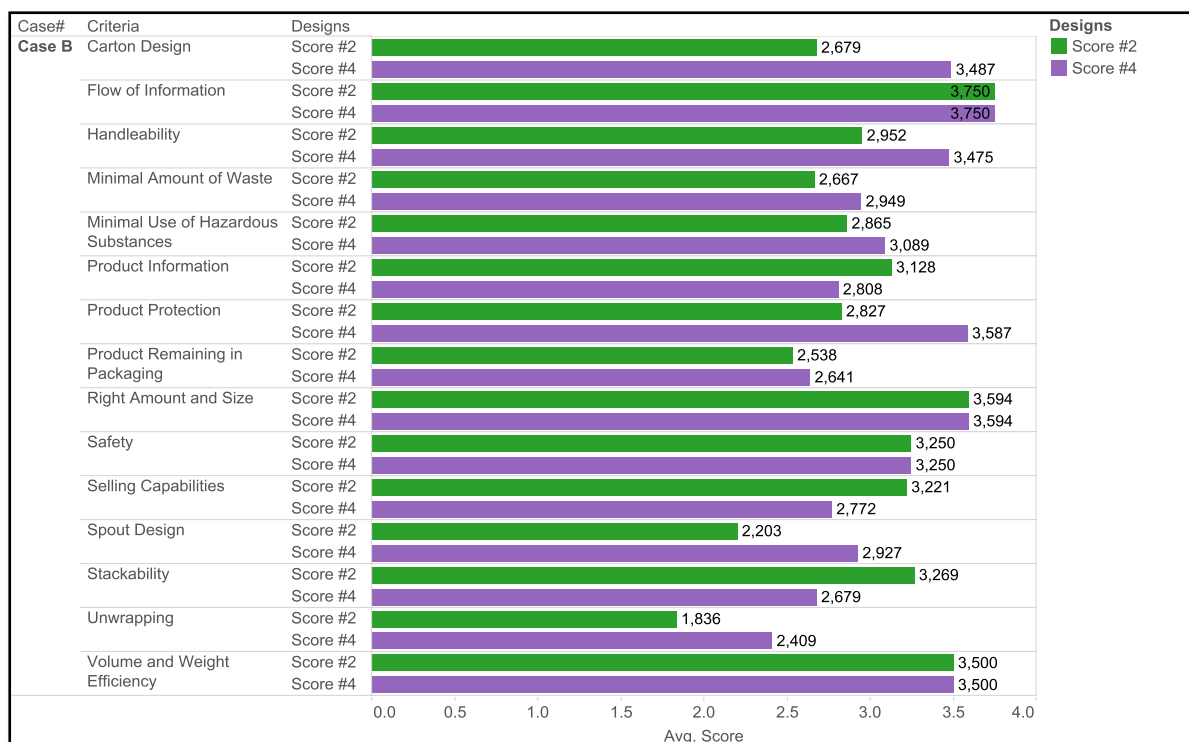


Figure 5.10: Average score per packaging criteria from the two packaging designs in Case Study B.

Packaging design #2 is shown in green and packaging design #4 is shown in purple. Since this graph only depicts the better packaging design per packaging criteria and cannot distinguish which packaging criteria scored the highest/lowest, the data should be listed in a table.

Packaging design #4 seems to have higher scores than packaging design #2. The scorecard results of Case Study B are compared in *Table 5.3* where the scores for each packaging design are sorted from highest to lowest.

The three criteria scoring the highest on packaging design #2 are flow information (3.750), right amount and size (3.594) and volume and weight efficiency (3.500). The three criteria scoring the lowest are unwrapping (1.836), spout design (2.203) and product remaining in packaging (2.538).

The highest scoring criteria for packaging design #4 are flow information (3.750), right amount and size (3.594), and product protection (3.587). The three criteria scoring the lowest are unwrapping (2.409), product remaining in packaging (2.641), and stackability (2.679).

Table 5.3: Packaging criteria's average scores ranked from highest to lowest for the two designs in Case Study B.

	Criteria	Packaging Design #2		Criteria	Packaging Design #4
1	Flow Information	3.750	1	Flow Information	3.750
2	Right Amount and Size	3.594	2	Right Amount and Size	3.594
3	Volume and Weight Efficiency	3.500	3	Product Protection	3.587
4	Stackability	3.269	4	Volume and Weight Efficiency	3.500
5	Safety	3.250	5	Carton Design	3.487
6	Selling Capabilities	3.221	6	Handleability	3.475
7	Product Information	3.128	7	Safety	3.250
8	Handleability	2.952	8	Minimal use of hazardous substances	3.089
9	Minimal use of hazardous substances	2.865	9	Minimal amount of waste	2.949
10	Product Protection	2.827	10	Spout Design	2.927
11	Carton Design	2.679	11	Product Information	2.808
12	Minimal amount of waste	2.667	12	Selling Capabilities	2.772
13	Product Remaining in Packaging	2.538	13	Stackability	2.679
14	Spout Design	2.203	14	Product Remaining in Packaging	2.641
15	Unwrapping	1.836	15	Unwrapping	2.409

In order to indicate which packaging design is the best overall, a combined total weighted score per design can be depicted. It will show combined results from the graph above.

c. Total weighted score per design broken down by actor

The weighted scores per design are depicted in *Figure 5.11* for the retailers, *Figure 5.12* for the consumers, and *Figure 5.13* as a combination.

Results from the retailers show that packaging design #2 has a weighted score of 3.471 and packaging design #4 has a weighted score of 3.524. Results from the consumers show that packaging design #2 has a weighted score of 2.696 and packaging design #4 has a weighted score of 2.992. Combined results show that packaging design #2 has a weighted score of 2.715 and packaging design #4 has a weighted score of 3.005.

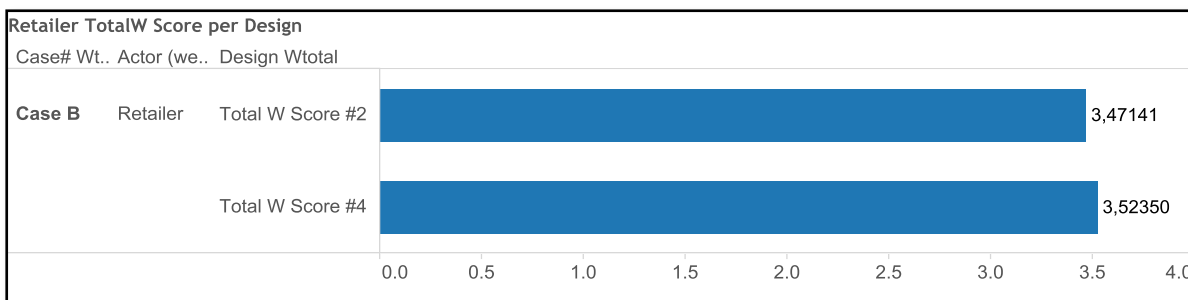


Figure 5.11: Total weighted score given by retailers for each design in Case Study B.

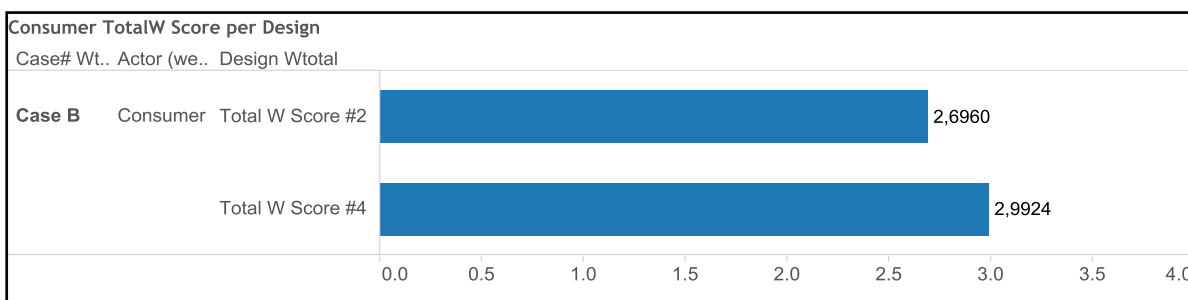


Figure 5.12: Total weighted score given by consumers for each design in Case Study B.

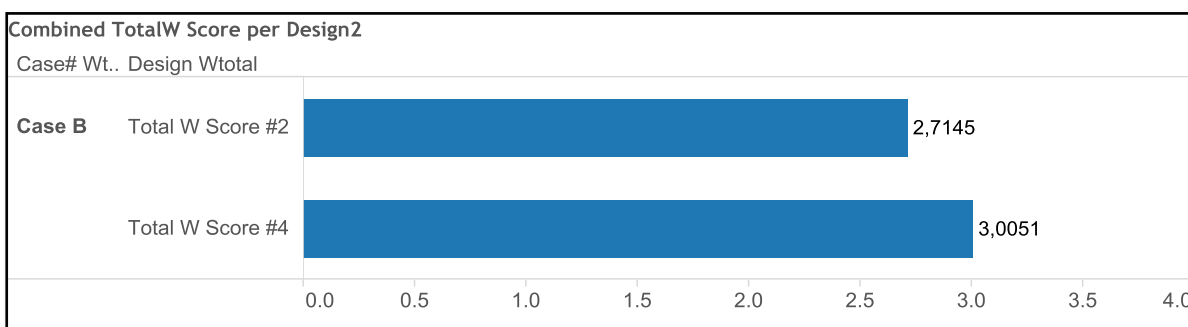


Figure 5.13: Combined total weighted score for each design in Case Study B.

These scores indicate that, according to the participating consumers and retailers, packaging design #4 is a better packaging design according to the packaging criteria listed in the packaging scorecard. Hence, if design changes are considered, they should be considered for packaging design #2. Furthermore, in order to indicate which packaging criteria are the best or worst overall, a combined score per criteria can be depicted.

d. Score per criterion

Finally, in order to identify the criteria scoring well or poorly, which may be useful to know for packaging design and development improvements, one more graph is required. This bar graph, showing the combined weighted score per criteria, can be seen in *Figure 5.14*. By

looking at this graph, it can be easily determined which packaging criteria scored the lowest in the combination of designs in Case Study B.

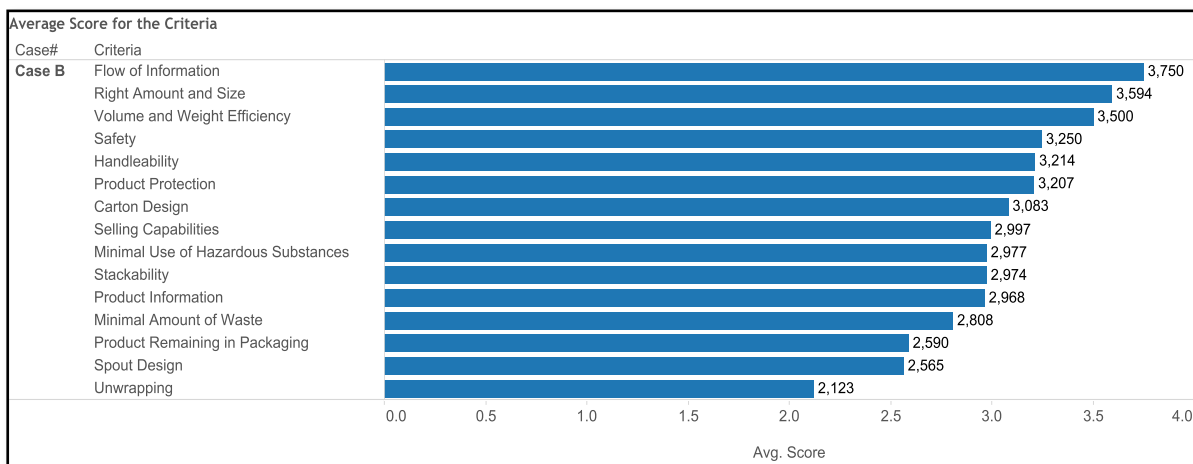


Figure 5.14: Average score for the criteria in Case Study B.

The three criteria scoring the highest are flow information (3.750), right amount and size (3.594), and volume and weight efficiency (3.500).

The three criteria scoring the lowest are unwrapping (2.123), spout design (2.565), and product remaining in packaging (2.590).

e. Final discussion

According to the participating retailers and consumers, packaging design #4 is a better packaging design when compared to packaging design #2. The following can be considered when approaching the redesign or development of a new packaging design in terms of research question two:

Firstly, the spout design score for packaging design #4 is much higher than for design #2. Furthermore, the carton design for packaging design #4 is also higher. Stackability for packaging design #2, in turn, is much higher than design #4. Hence, design improvements could focus on redesigning the spout design (using design #4's spout design) as well as improving the carton design. All of this could be changed for packaging design #2 while maintaining good stackability. For the consumers, a carton design affects marketing and customer's perception since the primary packaging comes in direct contact with the consumer (Pålsson, 2012).

Secondly, the criterion scoring the lowest in case study B is unwrapping. Unwrapping affects the overall efficiency for retailers. The faster the item is unwrapped, the quicker it can get on the shelf and therefore decreases the handling time of the packaging (Hellström & Saghir, 2007). Unwrapping also affects the consumer. The consumers' experience with the primary packaging should allow for easy opening and consumption (where possible) of the product, especially if the consumers are of different ages and genders (Pålsson, 2013). Furthermore, different kind of spout designs and carton designs affect the unwrapping of some packaging designs. Spout designs and carton designs for packaging designs #2 and #4 can therefore be considered to be redesigned or improved through a packaging design and development process.

5.1.3. Case Study C

The product manufacturers represented in Case Study C uses three different carton designs and three different spout designs. Packaging Design #3, Packaging design #6, and Packaging Design #7 can be seen in *Figure 5.15*.

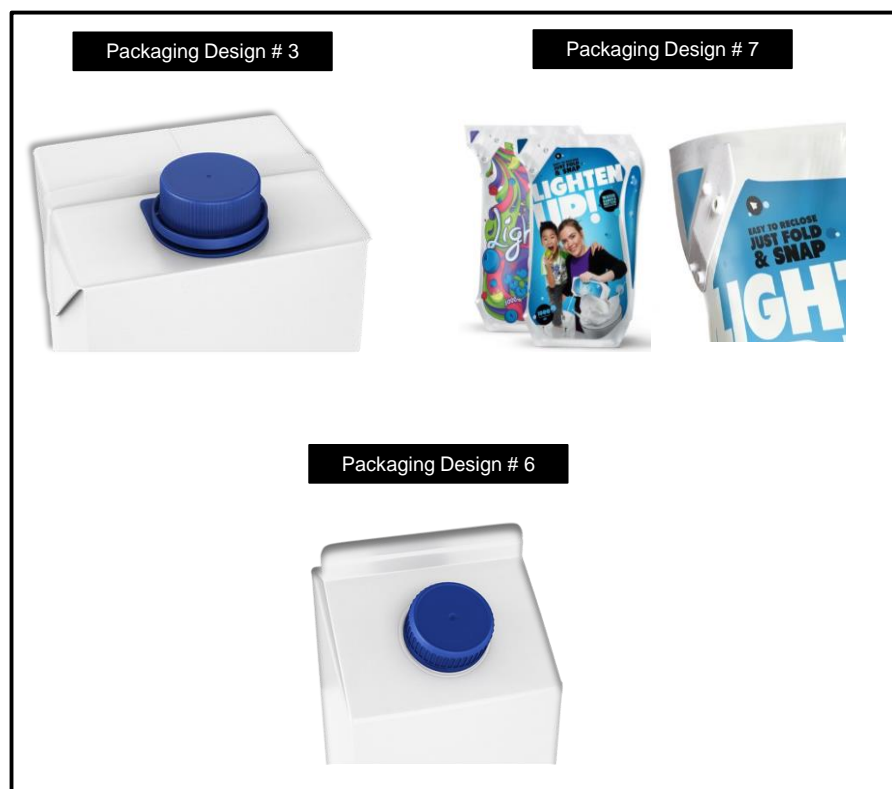


Figure 5.15: The three packaging designs used in Case Study C.

a. Weight for each criterion

A combined criteria score for Case Study C is illustrated in *Figure 5.16*.

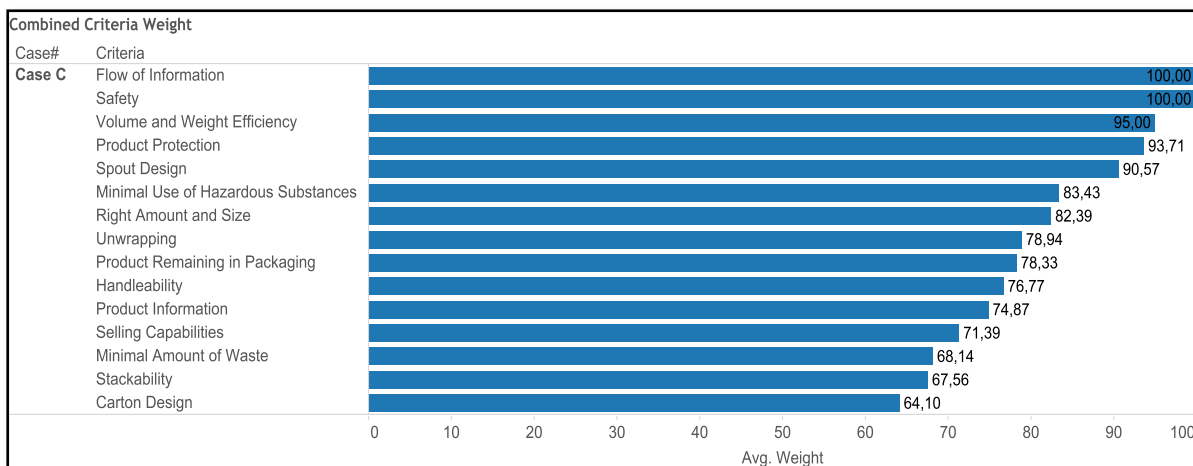


Figure 5.16: Weight for each criterion in Case Study C.

The top five important packaging criteria identified for the two designs in Case Study C are flow of information, safety, volume and weight efficiency, product protection, and the spout design. Therefore, when considering design changes, it could be beneficial to emphasise focus on the latter criteria. Hence, a score for each criterion is required.

b. Score for each criterion broken down by designs

The combined results from the retailers and consumers are shown in *Figure 5.17*. The scores for each criterion are broken down in terms of design. Packaging design #3 is shown in red, packaging design #6 in brown, and packaging design #7 is shown in pink. It should be noted that packaging design #7 is only displayed at packaging criteria related to consumers, since the retailers did not participate in evaluating packaging design #7.

It is difficult to distinguish which packaging design scored higher for each packaging criteria. Therefore, the scorecard results of Case Study C are compared in *Table 5.4* where the scores for each packaging design are sorted from highest to lowest.

The three criteria scoring the highest on packaging design #3 are unwrapping (3.891), flow of information (3.750), and right amount and size (3.594). The three criteria scoring the lowest for packaging design #3 are product remaining in packaging (2.128), selling capabilities (2.424), and stackability (2.449).

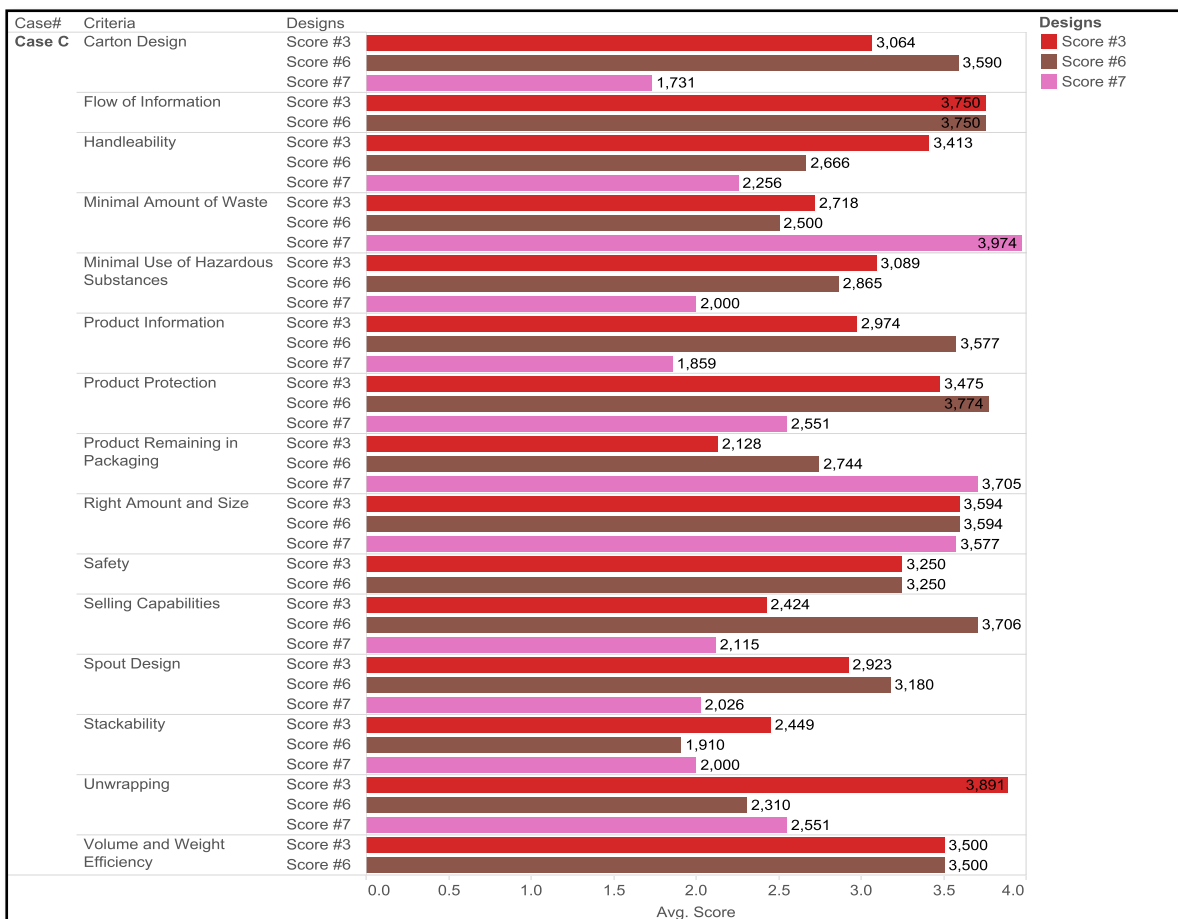


Figure 5.17: Average score per packaging criteria from the three packaging designs in Case Study C.

The criteria scoring the highest on packaging design #6 are product protection (3.774), flow of information (3.750), and selling capabilities (3.706). The three criteria scoring the lowest for packaging design #6 are stackability (1.910), unwrapping (2.310), and minimal amount of waste (2.500).

The criteria scoring the highest on packaging design #7 are minimal amount of waste (3.974), product remaining in packaging (3.705), and right amount and size (3.577). The three criteria scoring the lowest for packaging design #7 are carton design (1.731), product information (1.859), and stackability (2.000).

It can be noted that packaging design #7 has very low scores when compared to the other two designs. However, there are indications of some packaging criteria that perform better on packaging design #7.

Table 5.4: Packaging criteria's average scores ranked from highest to lowest for the three designs in Case Study C.

	Criteria	Packaging Design #3
1	Unwrapping	3.891
2	Flow Information	3.750
3	Right Amount and Size	3.594
4	Volume and Weight Efficiency	3.500
5	Product Protection	3.475
6	Handleability	3.413
7	Safety	3.250
8	Minimal use of hazardous substances	3.089
9	Carton Design	3.064
10	Product Information	2.974
11	Spout Design	2.923
12	Minimal amount of waste	2.718
13	Stackability	2.449
14	Selling Capabilities	2.424
15	Product Remaining in Packaging	2.128

	Criteria	Packaging Design #6
1	Product Protection	3.774
2	Flow Information	3.750
3	Selling Capabilities	3.706
4	Right Amount and Size	3.594
5	Carton Design	3.590
6	Product Information	3.577
7	Volume and Weight Efficiency	3.500
8	Safety	3.250
9	Spout Design	3.180
10	Minimal use of hazardous substances	2.865
11	Product Remaining in Packaging	2.744
12	Handleability	2.666
13	Minimal amount of waste	2.500
14	Unwrapping	2.310
15	Stackability	1.910

	Criteria	Packaging Design #7
1	Flow Information	N/A
2	Safety	N/A
3	Volume and Weight Efficiency	N/A
4	Minimal amount of waste	3.974
5	Product Remaining in Packaging	3.705
6	Right Amount and Size	3.577
7	Product Protection	2.551
8	Unwrapping	2.551
9	Handleability	2.256
10	Selling Capabilities	2.115
11	Spout Design	2.026
12	Minimal use of hazardous substances	2.000
13	Stackability	2.000
14	Product Information	1.859
15	Carton Design	1.731

In order to indicate which packaging design is the overall best, a combined total weighted score per design can be depicted. It will show combined results from the graph above.

c. Total weighted score per design broken down by actor

The weighted scores per design are depicted in *Figure 5.18* for the retailers, *Figure 5.19* for the consumers, and *Figure 5.20* as a combination. As mentioned earlier, packaging design #7 is not present in the results from the retailers.

Results from the retailers show that packaging design #3 has a weighted score of 3.423 and packaging design #6 has a weighted score of 3.449. Results from the consumers show that packaging design #3 has a weighted score of 2.935, packaging design #6 a weighted score of 2.991, and packaging design #7 has a weighted score of 2.582. Combined results show that packaging design #3 has a weighted score of 2.947, packaging design #6 a weighted score of 3.002, and packaging design #7 has a weighted score of 2.582.

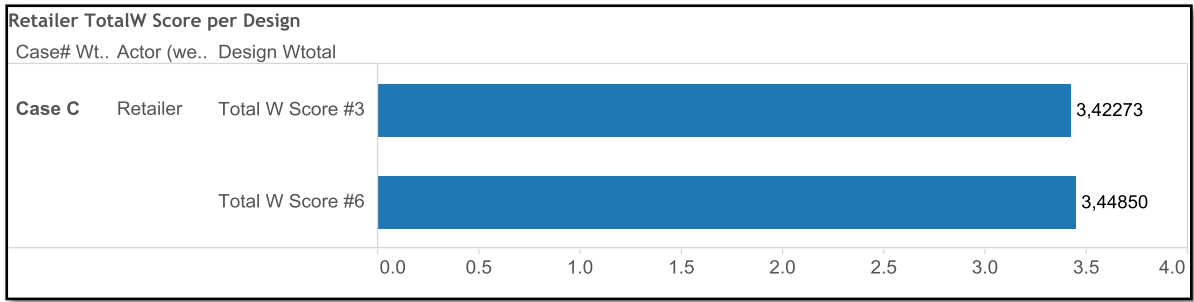


Figure 5.18: Total weighted score given by retailers for each design in Case Study C.

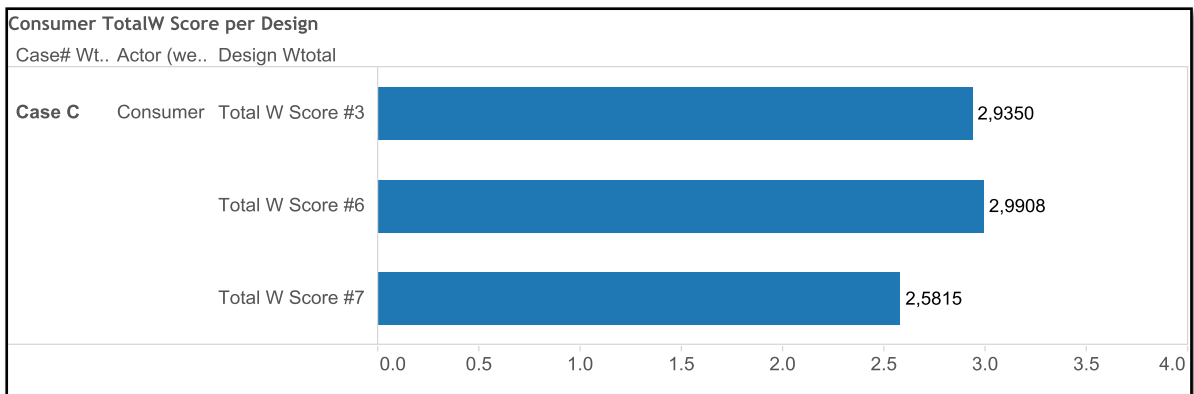


Figure 5.19: Total weighted score given by consumers for each design in Case Study C.

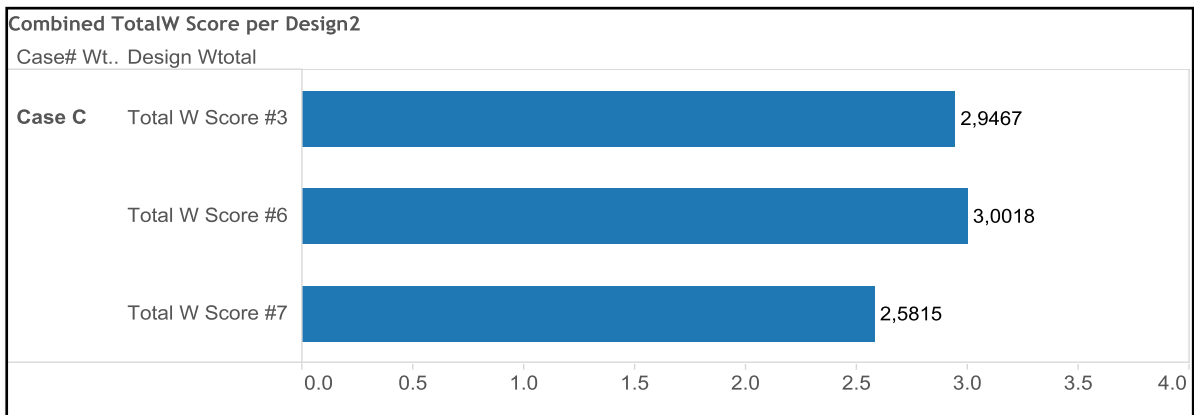


Figure 5.20: Combined total weighted score for each design in Case Study C.

This indicates that, according to the participating consumers and retailers, packaging design #6 is a better packaging design according to the packaging criteria listed in the packaging scorecard when compared to the other designs. Hence, if design changes are considered, they should be considered for packaging design #3 or #7. Furthermore, in order to indicate which packaging criteria are the best or worst overall, a combined score per criterion can be depicted.

d. Score per criterion

Finally, in order to identify the criteria scoring well or poorly, which may be useful to know for packaging design and development improvements, the final graph is required. This bar graph, showing the combined weighted score per criteria, can be seen in *Figure 5.21*. By looking at this graph, it can be easily determined which packaging criteria scored the lowest in the combination of designs in Case Study C.

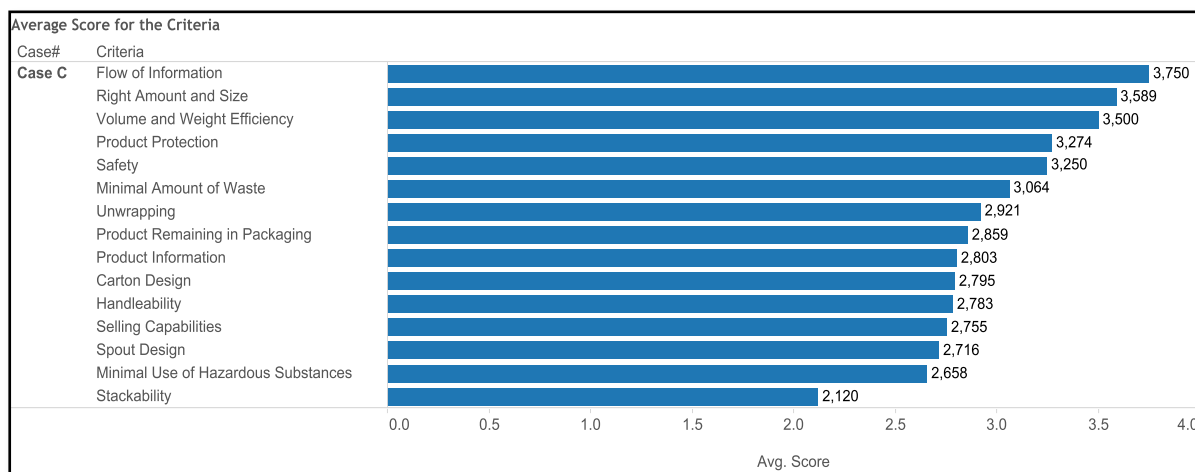


Figure 5.21: Average score for the criteria in Case Study C.

The three criteria scoring the highest are flow information (3.750), right amount and size (3.589), and volume and weight efficiency (3.500).

The three criteria scoring the lowest are stackability (2.120), minimal use of hazardous substances (2.658), and spout design (2.716).

e. Final discussion

According to the participating retailers and consumers, packaging design #6 is a better packaging design when compared to packaging design #3 and #7. The following can be considered when approaching the redesign or developing a new packaging design in terms of research question two:

Firstly, stackability has a low score for all three designs, spout design has a low score for design #3 and design #7, and product remaining in packaging has a low score for design #3 and #6. Hence, design improvements could focus on redesigning the spout design (using design #6's spout design) as well as improving the stackability. Similar to packaging design #5, design #6 contains a seal at the spout. As soon as the spout is opened for the first time, the seal is broken. Therefore, if considering redesigning packaging design #1, a similar

unwrapping concept as in design #6 could be used to ultimately gain the product remaining in the packaging ability of packaging design #7. For the consumers, reducing the product remaining in packaging is an important factor. This was explained in the problem statement in Introduction of this study.

Secondly, the criterion scoring the lowest in Case Study C is stackability. As mentioned in Case Study A, a change in the carton design or spout design may affect the stackability of a packaging design. Stackability and spout design for packaging designs #3, #6, and #7 can therefore be considered to be redesigned or improved through a packaging development process.

5.1.4. Combined Results

The combined results show the results from all the case studies, which include all the different packaging designs. Combining the results will be a good indication of the overall performance and importance of the packaging criteria and each packaging design.

a. Weight for each criterion

Figure 5.22 shows the combined criteria weight of all the packaging designs from all the supply chain actors. The top five overall most important packaging criteria identified are flow information, safety, volume and weight efficiency, product protection, and the spout design. Therefore, when considering design changes, it could be beneficial to emphasise focus on the latter criteria. Hence, a score for each criterion is required.

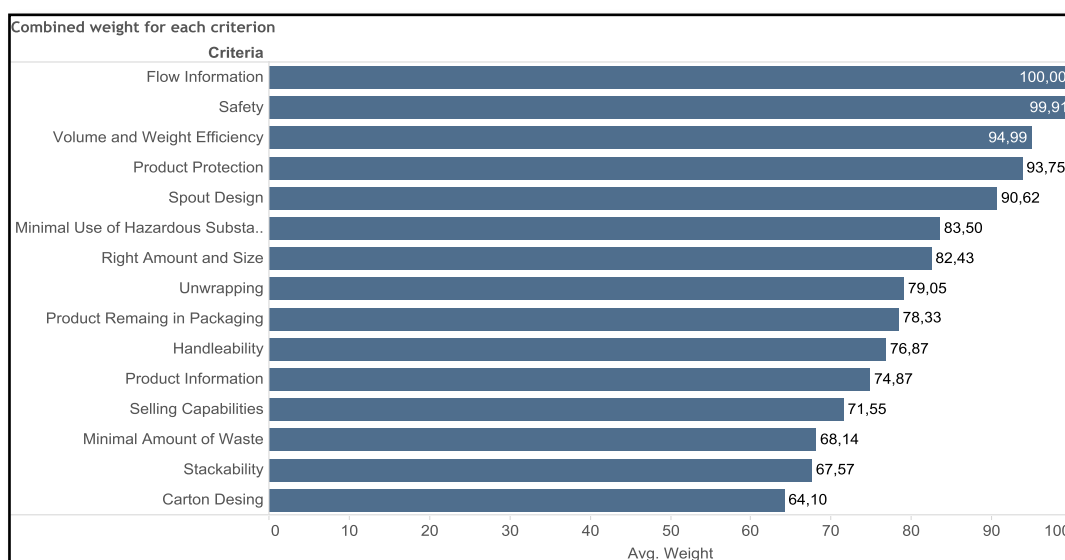


Figure 5.22: Combined weight for each criterion.

b. Score for each criterion broken down by design

This section is presented differently to the previous results for the three case studies. Certain criteria will be chosen, which will then be each analysed according to all the packaging designs. The criteria will be chosen based on similar previous observations by scholars, in interviews and through results from this study in terms of weight per criterion and score per criterion (criteria that score poorly). Hence, *Table 5.5* represents the possible criteria that will be analysed individually.

Table 5.5: Most used packaging criteria according to scholars, interviews, and research results.

Criteria	Sources						Total Count
	Olsmats & Dominic (2003)	Williams <i>et al.</i> (2008)	Svanes <i>et al.</i> (2010)	Pålsson (2013)	Towman (2013)	This Research Results	
Carton Design				•		•	2
Handleability	•		•		•		3
Minimal Use of Hazardous Substances	•	•	•		•	•	5
Spout Design		•		•		•	3
Stackability	•	•			•	•	4
Product Remaining in Packaging		•		•		•	3
Unwrapping	•					•	2
Selling Capabilities	•	•	•		•		4
Product Protection	•	•	•		•	•	5
Right Amount and Size	•	•	•		•	•	5
Product Information	•	•			•		3

For the sake of this research, product information, right amount, and size and selling capabilities will be ignored. The latter three criteria are either fixed or does not have any effect on the packaging efficiency. Product information and selling capabilities are mostly affected by the product manufacturer. The right amount and size for all the packaging designs are fixed at 1-litre and will not be changed for the sake of this research. The product information as well as some selling capabilities is designed during the artwork or graphic

design phase. This phase differs between various product manufacturers. Therefore, the graphic design should not influence the packaging criteria decisions. Right amount and size should also be ignored since the packaging designs in question are all 1 litre in size.

Henceforth, the scores for carton design, handleability, minimal use of hazardous substances, spout design, stackability, product remaining in packaging, unwrapping, and product protection will be shown. The following results were found using the average score:

Carton Design Scores

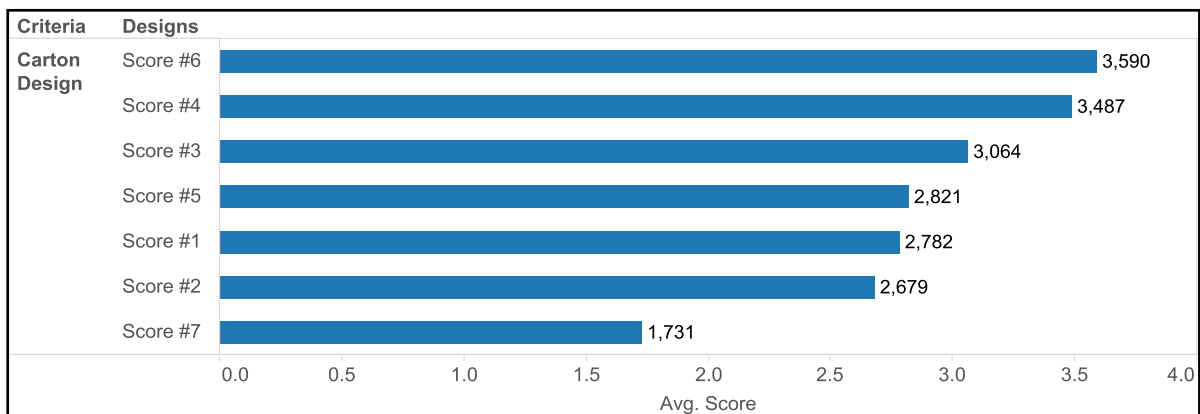


Figure 5.23: Carton Design average score for each design.

As seen in *Figure 5.23* for the carton design, the two designs scoring the highest are packaging design #6 (3.590) and packaging design #4 (3.487). The two designs scoring the lowest are packaging design #7 (1.731) and packaging design #2 (2.679).

Handleability Scores

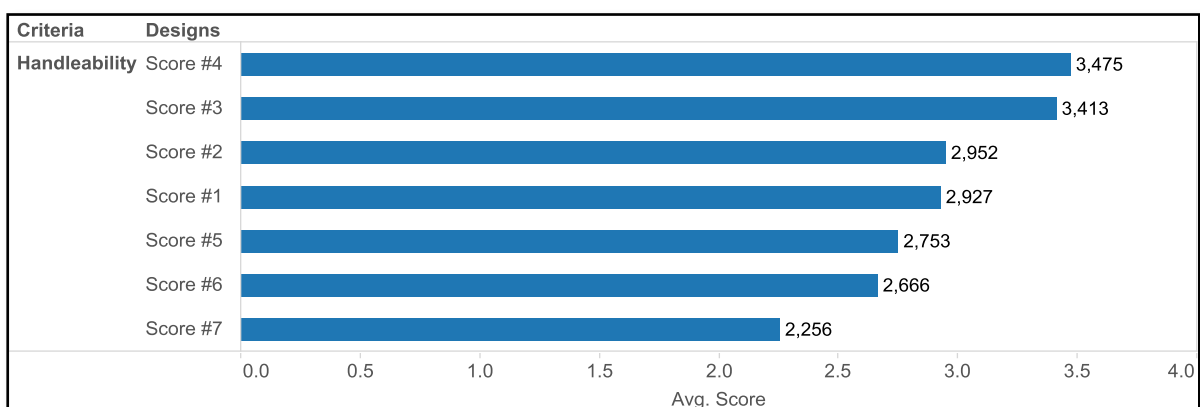


Figure 5.24: Handleability average score for each design.

As seen in *Figure 5.24* for handleability, the two designs scoring the highest are packaging design #4 (3.475) and packaging design #3 (3.413). The two designs scoring the lowest are packaging design #7 (2.256) and packaging design #6 (2.666).

Minimal Use of Hazardous Substances Scores

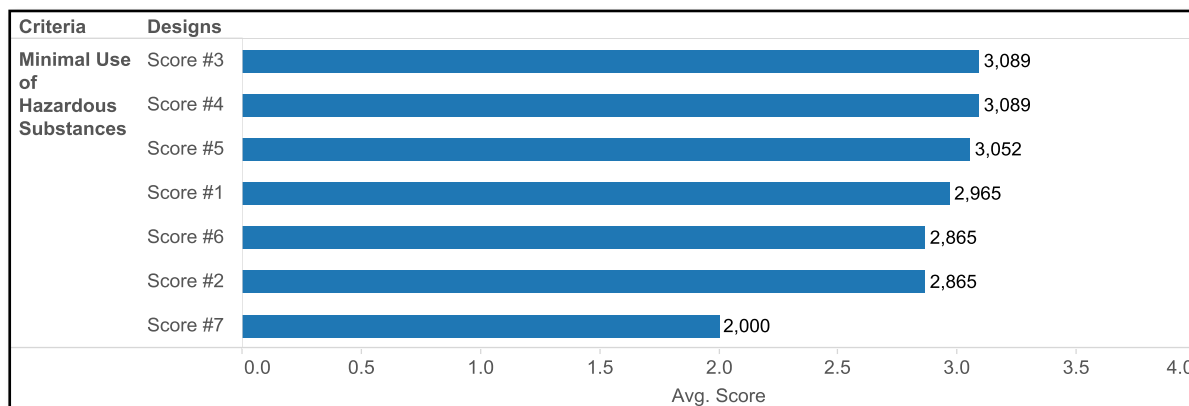


Figure 5.25: Minimal use if hazardous substances average score for each design.

As seen in *Figure 5.25* for minimal use of hazardous substances, the two designs scoring the highest are packaging design #3 (3.089) and packaging design #4 (3.089). The two designs scoring the lowest are packaging design #7 (2.000) and packaging design #6 (2.865).

Spout Design Scores

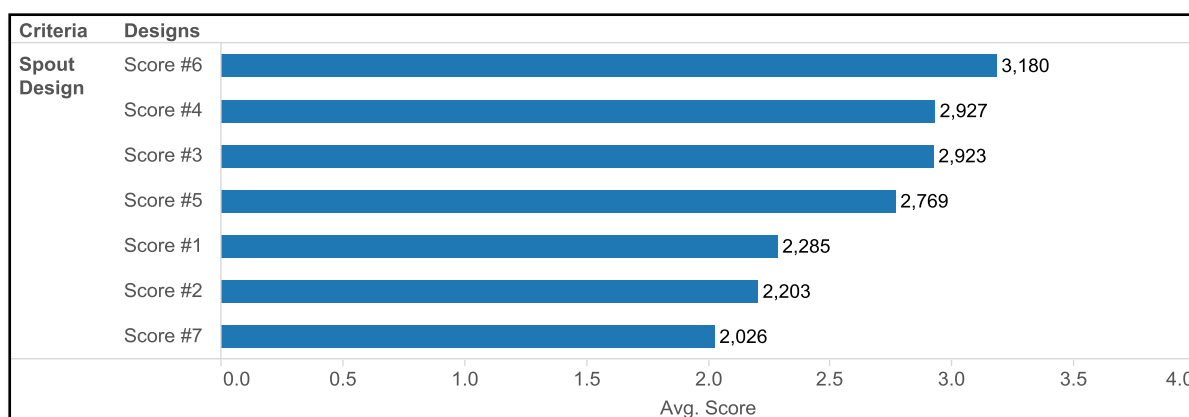


Figure 5.26: Spout design average score for each design.

As seen in *Figure 5.26* for the spout design, the two designs scoring the highest are packaging design #6 (3.180) and packaging design #4 (2.927). The two designs scoring the lowest are packaging design #7 (2.026) and packaging design #2 (2.203).

Stackability Scores

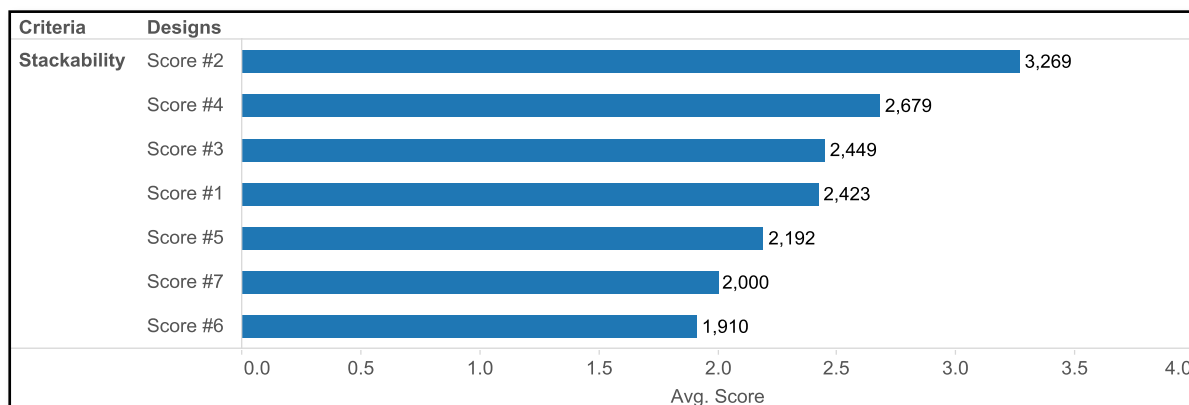


Figure 5.27: Stackability average score for each design.

As seen in *Figure 5.27* for stackability, the two designs scoring the highest are packaging design #2 (3.269) and packaging design #4 (2.679). The two designs scoring the lowest are packaging design #6 (1.910) and packaging design #7 (2.000).

Product Remaining in Packaging Scores

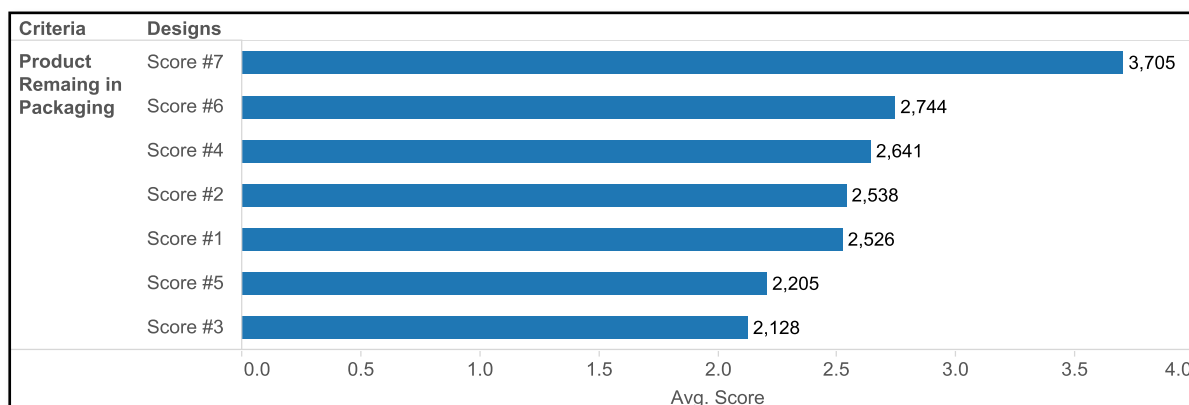


Figure 5.28: Product remaining in packaging average score for each design.

As seen in *Figure 5.28* for product remaining in packaging, the two designs scoring the highest are packaging design #7 (3.705) and packaging design #6 (2.744). The two lowest scoring designs are packaging design #3 (2.128) and packaging design #5 (2.205). It can be seen that the packaging design not used in South Africa (packaging design #7) has the highest score. Although this specific design has lower average scores for other packaging criteria, it performs well with product remaining in the packaging.

Unwrapping Scores

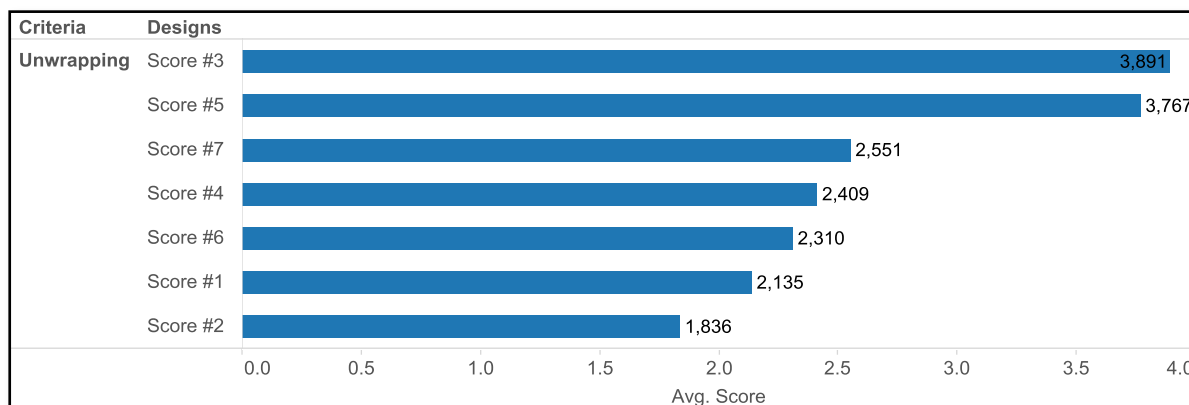


Figure 5.29: Unwrapping average score for each design.

As seen in *Figure 5.29* for unwrapping, the two designs scoring the highest are packaging design #3 (3.891) and packaging design #5 (3.767). The two designs scoring the lowest are packaging design #2 (1.836) and packaging design #1 (2.135).

Finally, as seen in *Figure 5.30* for product protection, the two designs scoring the highest are packaging design #6 (3.774) and packaging design #4 (3.587). The two designs scoring the lowest are packaging design #7 (2.551) and packaging design #2 (2.827).

Product Protection Scores

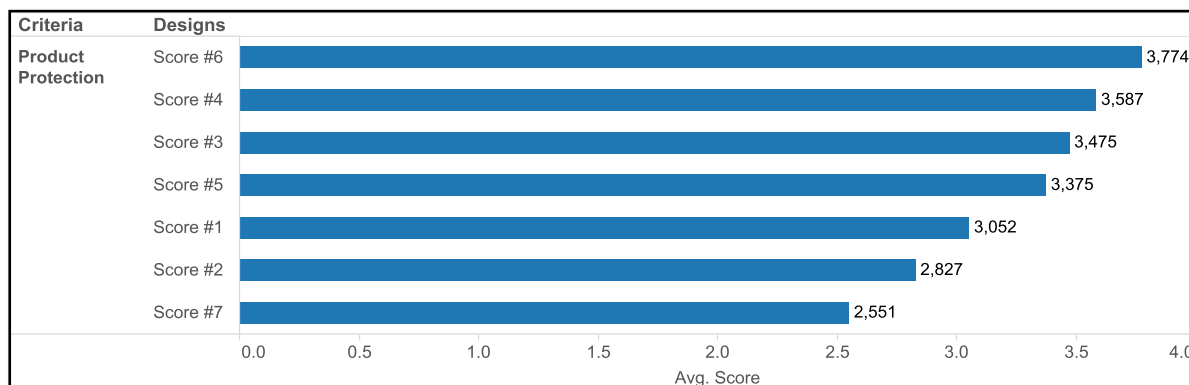


Figure 5.30: Product protection average score for each design.

To be able to visually represent the graphs above, all the results are depicted as the best criteria performance per design in *Table 5.6* and packaging design scoring the worst in *Table 5.7*. The goal is to identify the strongest and weakest packaging design according to the criteria identified in the beginning of this section.

Table 5.6: Best criteria performers per design.

Criteria	Packaging Design Number						
	#1	#2	#3	#4	#5	#6	#7
Carton Design						•	
Handleability				•			
Minimal Use of Hazardous Substances			•				
Spout Design						•	
Stackability		•					
Product Remaining in Packaging							•
Unwrapping			•				
Product Protection						•	
Total	0	1	2	1	0	3	1

Packaging design #7 scored the lowest in terms of the criteria identified in the beginning of this section where packaging design #6 scored the highest in the given criteria. However, there are some criteria from design #6 that also scored very low.

Table 5.7: Lowest criteria performers per design.

Criteria	Packaging Design Number						
	#1	#2	#3	#4	#5	#6	#7
Carton Design							•
Handleability							•
Minimal Use of Hazardous Substances							•
Spout Design							•
Stackability						•	
Product Remaining in Packaging			•				
Unwrapping		•					
Product Protection							•
Total	0	1	1	0	0	1	5

Therefore, when considering design changes, the criteria achieving high scores for each packaging design may be considered. Hence, the total weighted score per design can be calculated.

c. Total weighted Score per design broken down by actor

The total weighted scores per design are depicted in *Figure 5.31*. The combined results show that packaging design #4, with an average weighted score of 3.0051, scored the highest and packaging design #7 scored the lowest with an average weighted score of 2.5815 with design #2 second to last with a score of 2.7145.

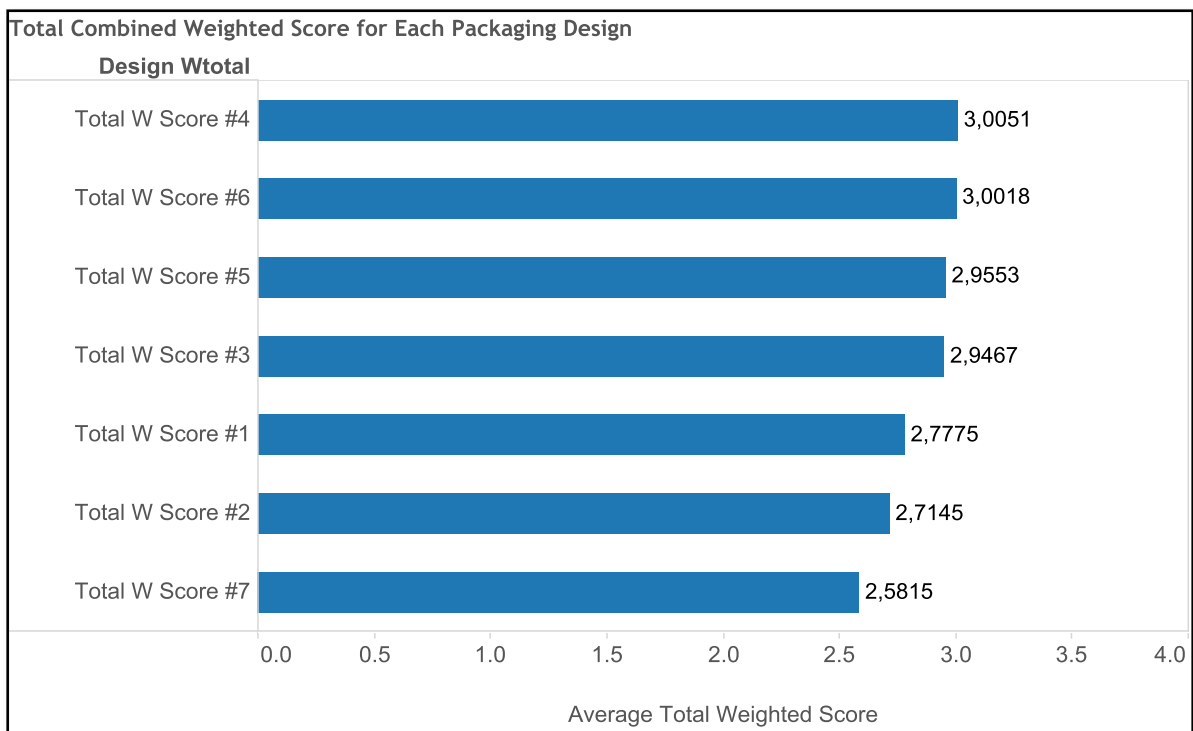


Figure 5.31: Total combined weighted score for each design.

This indicates that, according to the participating consumers and retailers, packaging design #4 is the best overall packaging design and design #7 is the worst. Hence, if design changes are considered, it should be considered for packaging design #7. However, packaging design #7 was used in order to identify whether it can be competitive in the South African market.

Since packaging design #7 scored the lowest, this packaging design might not seem viable to consider such a packaging design. Packaging design #2 should rather be considered for change. It is possible to see which packaging criteria scored high in terms of design #7, since that may be used to bring design changes to other packaging designs already used in South Africa. Therefore, in order to indicate which packaging criteria are the best overall, a combined score per criteria can be depicted.

d. Score per criterion

The final graph illustrates the packaging criteria that score well or poorly. The combined average scores are depicted in *Figure 5.32*.

The three highest scoring criteria are flow information (3.747), right amount and size (3.592), and volume and weight efficiency (3.497). The three criteria scoring the lowest are stackability (2.418), spout design (2.618), and product remaining in packaging (2.641).

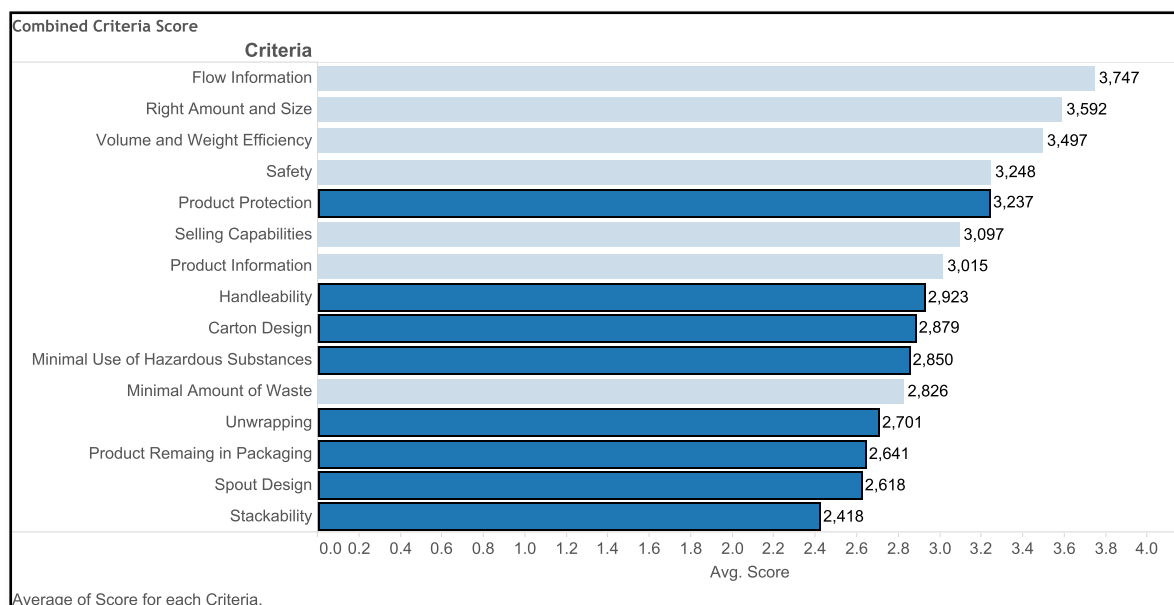


Figure 5.32: Average score for all and selected criteria.

The eight packaging criteria identified previously in the combined results section are highlighted in darker blue in *Figure 5.32*. From these results, the three criteria scoring the highest are product protection (3.237), Handleability (2.923), and carton design (2.879). The three criteria scoring the lowest are stackability (2.418), spout design (2.618), and product remaining in packaging (2.641).

e. Final discussion

The criteria scoring the lowest/highest identified for each packaging design could support the changing of a current design or designing a new packaging solution based on the results. Stackability, spout design, and product remaining in packaging were the three criteria scoring the lowest identified in the combined results. Packaging design #2 had the best overall score for stackability. Packaging design #6 had the best overall score for spout design. Packaging design #7 had the best overall score for product remaining in packaging.

5.1.5. Summary of case studies and combined results

Case Study A

The following results were found:

- The criterion scoring the lowest for packaging design #1 was unwrapping and for packaging design #5 it was stackability.

- The three criteria scoring the lowest for both designs were stackability, minimal amount of waste, and product remaining in packaging.
- The combined total weighted score for packaging design #5 was higher than that of packaging design #1.

Therefore, packaging design #5 is considered better than design #1. When design or development decisions should be made for the results in Case Study A, they could be made for packaging design #1 with emphasis on stackability, minimal amount of waste, and product remaining in packaging.

Case Study B

The following results were found:

- The criterion scoring the lowest for packaging design #2 was unwrapping and for packaging design #4 it was also unwrapping.
- The three criteria scoring the lowest for both designs were unwrapping, spout design, and product remaining in packaging.
- The combined total weighted score for packaging design #4 was higher than that of packaging design #2.

Therefore, packaging design #4 is considered better than design #2. When design or development decisions should be made for the results in Case Study B, they could be made for packaging design #2 with emphasis on unwrapping, spout design, and product remaining in packaging.

Case Study C

The following results were found:

- The criterion scoring the lowest for packaging design #3 was product remaining in packaging, for packaging design #6 it was stackability, and for packaging design #7 it was carton design.
- The three criteria scoring the lowest for all the three designs were stackability, minimal use of hazardous substances and spout design.
- The combined total weighted score for packaging design #6 was higher than that of packaging design #3 and #7.

Therefore, packaging design #6 is considered better than design #3 and packaging design #3 is considered better than design #7. When design or development decisions should be made for the results in Case Study C, they could be made for packaging design #7. However, since packaging design #7's purpose was mainly to see if it will work in the South African market (which according to the results it does not), packaging design #3 should be considered instead. Therefore, design or development decisions could be made with emphasis on stackability, minimal use of hazardous substances and spout design.

Combined Results

The following results were found:

- The three criteria scoring the lowest for both designs were stackability, spout design, and product remaining in packaging.
- The combined total weighted score shows that packaging design #4 is the best design and design #7 or design #2 is the worst.

According to Volmink (2013), packaging design #4 is shaped with an angle at the top section to allow for a minimal size air pocket caused by the sterilisation process during filling. This air pocket allows easy flow as soon as the injection seal is broken. The reason for this is that it prevents back pressure and suction of air into the spout area of the carton and thus allows for a free flow of the content (fruit juice) and may also decrease the spillage (Volmink, 2013). This can be a useful attribute to consider when thinking of making changes to a design. When design or development decisions should be made for all the packaging designs in this study, they could be made for packaging design #2 with emphasis on stackability, spout design and product remaining in packaging.

Henceforth, research question one included the following: “*By making use of a certain packaging evaluation model...*” This packaging evaluation model was the packaging scorecard. Question one continues with “*...which packaging criteria, in terms of packaging efficiency, should be improved...*” Packaging efficiency is applied to packaging systems (in this case primary packaging) and it includes ease of handling, logistics, traceability, protection, or anything related to the physical attributes of packaging in the supply chain (James, *et al.*, 2005; Olander-Roese & Nilsson, 2009; Sohrabpour, 2012). The packaging criteria to change were identified as the spout design (together with other criteria), which will effectively influence both stackability and product remaining in packaging criteria (Abassi,

2013; Björck, 2013; Pålsson, 2013; Volmink, 2013). Stackability influences coefficient of fullness in the packaging logistics chain when the product is transported and coefficient of fullness affects the efficiency in the supply chain (Sohrabpour, 2013).

When considering the design and development changes, the spout design criteria of these packaging designs (or specifically of design #3) could be used to assist in the decision-making process of the redesign or development process. This will be discussed further in the next section. The results from content analysis for the packaging development process are also discussed in the next section.

5.2. Results and Discussion on Research Question Two

Research question two:

Which theoretical packaging development process can be presented in order to develop the packaging in terms of the criteria identified in question one and is it possible for the process to be a generic development process?

The results for research question two are split into three sections. Section one will discuss the results from the content analysis coding (the first part of research question two) and section two will discuss the possibilities of a generic packaging development process (the second part of research question two). Section three will provide a summary of all the results gathered for research question one. The results obtained from the content analysis coding are presented below.

5.2.1. Results from Content Analysis

The following section is derived from the secondary data depicted in Chapter 3 of this study. The data from the content analysis was summarised and is depicted in *Appendix I: First Phase Results of the Content Analysis Coding*

There are seven columns – each containing information from all the development processes. These columns are the author, the word/phrase, the position in which it is represented, the relevant phases or steps, the number of times the word/phrase appears (count), the category it falls under, and the label given to the specific word/phrase. From this table, a new list can be deducted from the words/phrases followed by the count and median or average position. The

new list is showed in *Table 5.8*. It depicts the top fifteen words/phrases according to the number of times it occurred. The bottom seventeen words/phrases are not mentioned since the first fifteen represent more than 75% of the total count.

The words/phrases that are first in position of a sensible order are planning (count = 6) and packaging requirements (count = 2). In second position there are concept (count = 9), development (count = 4), and feasibility (count = 1). In third position there are design (count = 8), preproduction (count = 1), and capability (count = 1). In fourth position are graphic design (count = 4) and production planning (count = 3). The final phases are production (count = 5), launch (count = 4), and post-launch review (count = 1).

Table 5.8: Top fifteen words/phrases according to its count derived from content analysis coding.

New List	Count	Median Position	Average Position
Concept	9	2.0	2.3
Design	8	3.0	3.4
Planning	6	1.0	1.0
Production	5	5.0	5.6
Development	4	2.5	2.8
Launch	4	5.5	6.3
Graphic Design	4	4.0	4.8
Production Planning	3	4.0	3.7
Packaging Requirements	2	1.0	1.0
Project Proposal	1	1.0	1.0
Pre-production	1	3.0	3.0
Post-launch Review	1	5.0	5.0
Ideas	1	1.0	1.0
Feasibility	1	2.0	2.0
Capability	1	3.0	3.0

From the data gathered above, a network diagram can be compiled by consolidating phases, where possible, and combining everything into a practical and sensible order. The final list of plausible phases/steps for the packaging development process can be seen in *Figure 5.33*. The new list on the left-hand side is consolidated into the list to the right-hand side. The final list, in the order that a sensible phase may be derived from, include project proposal, packaging requirements, ideas and planning, design, concept, capability, graphic design production, launch, and post-launch review.

The following phases derived from *Figure 5.33* in the packaging development. Each phase has a decision-making process and should end with a completed goal. This was inspired by the Stage-Gate® theory and the development process from Bramklev (2009). Each phase will be explained briefly. The redesign process is intended for packaging manufacturers.

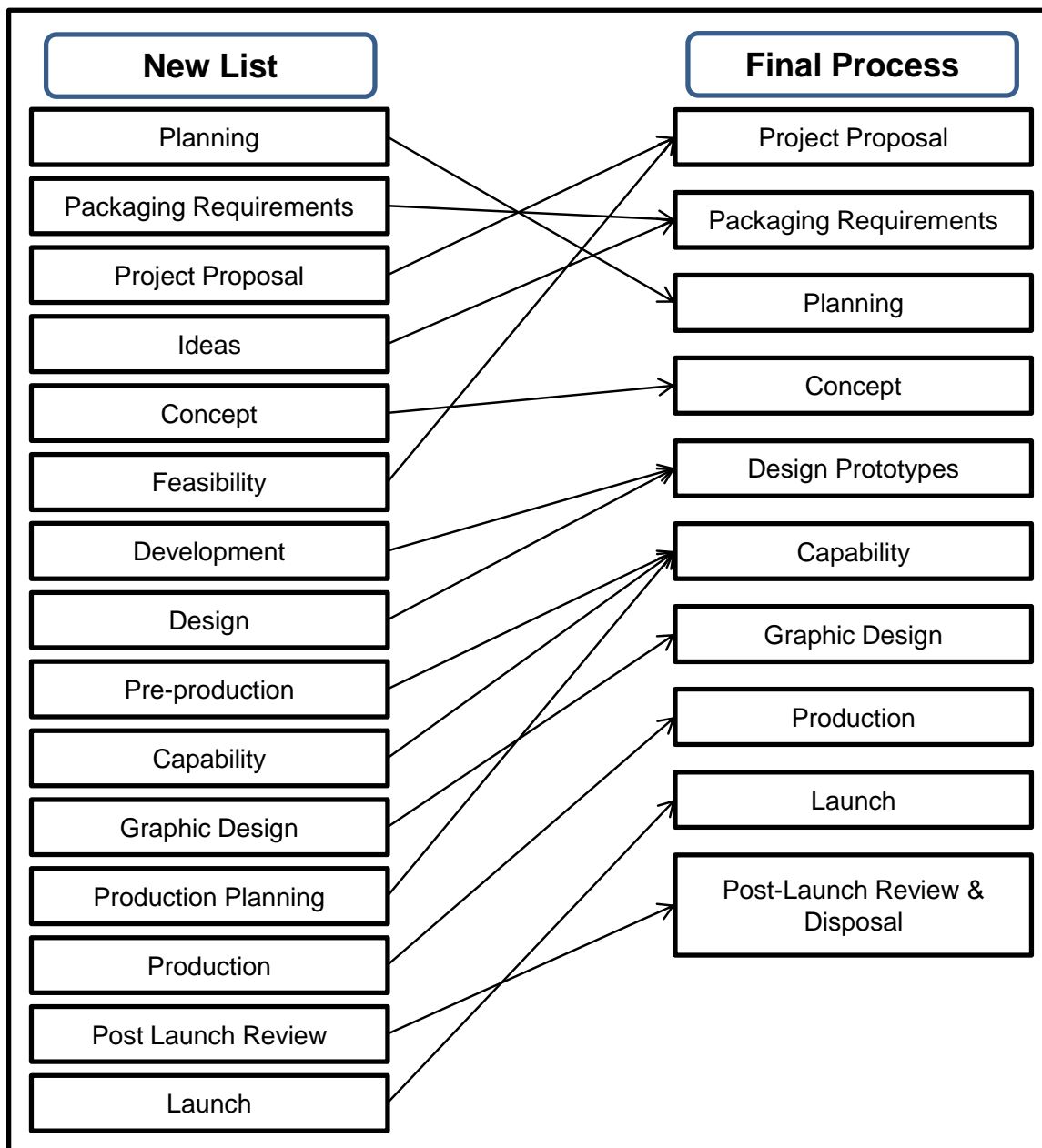


Figure 5.33: New list of words/phrases merged into a final list after coding.

Hence, the packaging redesign process with focus on designing a new spout design for packaging design number two, in order to improve stackability and product remaining in packaging. The phases and the goal of each phase are as follow:

Phase 1: Project Proposal

This phase starts with a request to make design changes to current packaging to management. The goal is for the design process to be approved by management after considering e.g. finances and marketing.

Phase 2: Packaging Requirements

Listing the packaging requirements are motivated by Collins II (2015) and Scheuneman and Tolette (2010). The packaging criterion that should change was identified as the spout design from the results on research question one. Therefore, the list of requirements, identified from the literature and results, should be listed before a packaging development process could be considered. It should influence all the actors in the supply chain with emphasis on consumers, since consumers are coming in direct contact with the packaging (Pålsson, 2012). The new spout design should:

- be redesigned to an existing carton design (not a new design from scratch) – influence packaging manufacturers;
- improve stackability – influence packaging manufacturers, product manufacturers, and retailers;
- reduce product remaining in packaging – influence consumers;
- increase product protection (from the external environment) – influence product manufacturers, retailers, and consumers;
- increase the ease of unwrapping and opening process – influence consumers;
- protect the packaging on secondary level while content is inside – influence product manufacturers, retailers, and consumers;
- reduce spillage when content is poured – influence consumers; and
- be recyclable and adhere to regulatory requirements – influence packaging manufacturer.

The goal is for the requirements to be listed that were identified by the packaging scorecard or any other relevant evaluation model. This was goal was informed by Eriksson and Towman (2004). As mentioned, earlier integration with the product-package system (PPS) is essential. However, since the product is already developed (fruit juice), the early integration of PPS is not of high importance.

Phase 3: Ideas and Planning

During this phase, any problems that may arise during the process should be identified and eliminated. This phase aims to give direction and vision to the project. This phase was inspired by Briston and Neill (1972) and DeMaria (2000). The goal is to understand the risks involved and create contingency plans. As soon as this is set in place, the process can move forward to the design phase.

Phase 4: Concept

This phase entails establishing the packaging specifications, generating package concepts, and then evaluating and selecting the packaging concepts. For a packaging redesign, this step could be low in costs and quick. The goal is to choose the best concepts that will meet the requirements listed in Phase 2.

Phase 5: Design Prototypes

This phase entails developing and selecting the samples scoring the highest. The samples may go through another packaging evaluation before it is approved. The prototype should meet the requirements outlined in Phase 2. The goal is to evaluate and decide on a prototype before moving ahead.

Phase 6: Capability

In this phase, it should be measured and planned whether the desired prototype can go into production. The capability phase starts with the documentation of the design of the packaging and generation, manufacturing, testing, and evaluation of tools. This phase may also include the training of workforce and evaluation of the progress and results of the final product. The capability phase is a production planning mindset where the goal is to do a manufacturing test run.

Phase 7: Graphic Designs

Artwork for the cartons can be designed. It includes the design drawing as well as the colour schemes and printing layout of the package in order to meet the customer demands. However, the artwork is mostly done by the product manufacturers, therefore this phase could be skipped. The goal is to finish the artwork for all the packaging levels (primary, secondary,

and tertiary) where required. If this is completed, the process can move forward towards the production phase.

Phase 8: Production

The production is initiated and early production output can be evaluated. The goal is to evaluate the production process to identify any errors that may occur.

Phase 9: Launch

Launch the redesigned packaging with the new spout design. Distribution to customers should be considered. The goal is to introduce the packaging to the market as effectively as possible.

Phase 10: Post-launch Review and Disposal

A review regarding the performance of the redesigned packaging as well as the production process should be executed in this phase. The goal is to establish whether the redesigned packaging improved the packaging criteria that were identified. The disposal of the product and packaging can also be tracked in order to measure whether minimum or no product remains in the packaging and whether the packaging materials are recycled.

Some of the phases mentioned above may be executed simultaneously. This was inspired by the stage-gate process. Executing the phases simultaneously may decrease the lead time of the entire process and might save on costs (Bramklev, 2009). It may be argued that it can be time-consuming and costly to develop a redesign process for a specific packaging design. Hence, a possibility of a generic packaging design or development process should be considered.

5.2.2. Considering a Generic Packaging Design and Development Process

Interviews with product manufacturers and a packaging manufacturer as well as considering literature from Bramklev (2009) and Paine (1991) suggest that there are packaging development processes for a specific packaging but the implementation of these processes are accompanied by many hurdles. The first hurdle, identified by Bramklev (2007), is that there are a number of different materials that are being used in a single packaging unit (Bramklev, 2007). The characteristics of the packaging development processes include a large and diversified proportion of aspects that are identified as affecting the content of the packaging

design and development process. It therefore represents the whole packaging ranking, the different materials, and the different packaging types (industrial, institutional, and consumer) (Bramklev, 2007). The different materials can include plastic, paper and corrugated board, and glass. The 1-litre carton discussed in this study falls under the material of paper and corrugated board. The pouring mechanism is plastic and therefore the one packaging already has two different material types. This increases the difficulty of generating a package specific development process (Paine, 1991).

The second hurdle is that of sensitivity of information in order to keep a competitive edge from a packaging manufacturer's point of view. From a product manufacturer's point of view, the packaging development process focuses more on design and artwork of the packaging than the packaging system as a whole. Hence, a theoretical packaging development process is created based on the results collected on question one, and not on a generic development process.

It is very important to remember that the above-mentioned list of phases cannot be seen as a generic packaging development phase. There is no significant information related to the above-mentioned table to create a generic packaging development process. There was no recognised procedure model that gives thorough guidance to a generic operational packaging design. Similar conclusions were made by Bramklev (2007) and ten Klooster (2002). No single reference for analysing the packaging development process theory achieved the standards of the definition to be considered generic. This meant that there were no existing descriptions of the packaging development process that provided reliable descriptions of a generic package development process. Therefore, it will be necessary to obtain more information about the packaging development process related to the specific packaging in question through empirical data or packaging evaluation in order to complement the existing theory; as done in this study.

5.2.3. Summary

The following redesign process was identified as a plausible solution to change the spout design on the packaging designs identified in this research. The phases that are possible to be carried out simultaneously are listed vertically and the timeline runs horizontally. The redesign process is illustrated in *Figure 5.34*.

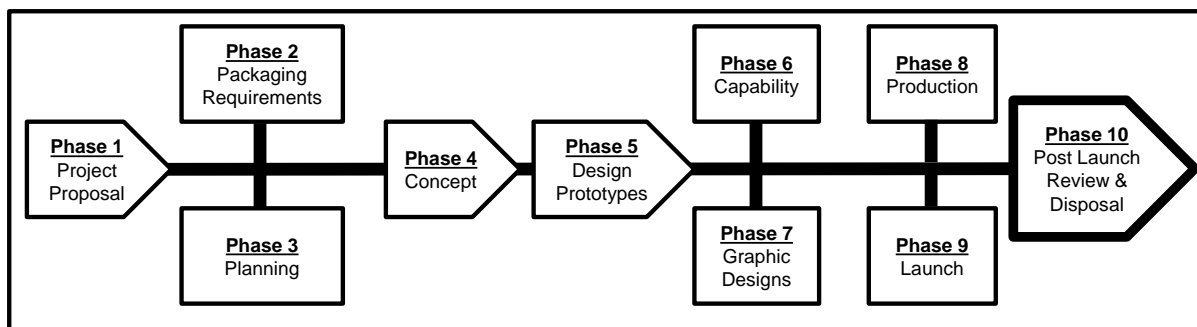


Figure 5.34: Packaging redesign process with emphasis on the spout design, stackability, and product remaining in packaging.

This process is a proposal to redesign the spout design on the packaging designs used in this research. It may be useful to make the changes to packaging design #2. This process is not a generic development process; instead, it is packaging or criteria-specific.

Henceforth, research question two included the following: *“Which theoretical packaging development process can be presented in order to develop the packaging in terms of the criteria identified...”* The theoretical packaging redesign process was consequently developed and presented. The final part of the research questions included the following: *“...and is it possible for the process to be a generic development process?”* Where the answer to this part is no, it is not possible.

5.3. Conclusions derived from Results and Discussions on the Problem Statement, research question one and research question two

The online questionnaire in phase one of this research provided some evidence that there is a need for packaging design changes to two of the 1-litre fruit juice cartons used in South Africa. This confirmed the validity of this research, which allowed it to move on to obtain the results from the packaging scorecard of the retailers and consumers.

The results from the packaging scorecard concluded the following: Case Study A identified packaging design #1 as the design performing the worst with changes required to unwrapping and the criterion scoring the lowest was stackability. Case Study B identified packaging design #2 as the design performing the worst with changes required to unwrapping and the criterion scoring the lowest was also unwrapping. Case Study C identified packaging design #7 as the design performing the worst with changes required to the carton design and the criterion scoring the lowest was stackability. Combined results (all the packaging designs)

identified packaging design #2 as the design performing the worst with changes required to the stackability packaging criteria.

Finally, it was decided that the content analysis results will be based on the combined results on research question one. The phases identified in the research question could be based on Case Study A, B, and C. The only theoretical change that will be required will be in phase two when stating the packaging requirements.

Chapter 6: Summary and Conclusion

Looking back to the beginning of this study, the information in the Introduction defined the environment in which packaging and product development are encountered. After some background was given on packaging logistics, packaging design, packaging evaluation, and packaging in South Africa, a knowledge gap was identified through personal observations, a video on social media, and an interview with a packaging manager in South Africa. As a result, it became evident that there was in fact a problem with the packaging designs for the fruit juice market in South Africa.

The knowledge gap turned into a problem statement and resulted in a primary research question and two secondary research questions. It was also mentioned that the research process was divided into two sections, where section one dealt with the problem statement and section two dealt with the two research questions. To test and prove the validity of the research, an exploratory online questionnaire was conducted. The results confirmed that not all consumers were satisfied with current designs and that there were ways to change the 1-litre fruit juice packaging designs. These findings allowed the study to progress and move on to the literature review.

In Literature Review, the relevant literature was explored. The literature review was based on key words/phrases that were derived from the title of this study. It provided a good understanding of the packaging logistics field. Ultimately, it assisted in understanding the integration of packaging development and doing it in a sustainable way. It also provided enough information to choose the packaging scorecard as the best packaging evaluation model. These are things that were good to keep in mind when completing the rest of the research or assisted with obtaining the research results.

The literature in Chapter 3 assisted in identifying the literature for product or packaging design and development processes (that was later used in secondary data analysis coding). However, before the latter two analysis tools could be implemented, the research design and methodology were explained in the next chapter.

Research Design and Methodology therefore explained how, why, where, when and by whom (key role players) this research will have been executed, also known as the design and methodology. The perspective from which this research was approached as well as the

design, methods, and techniques were identified and explained for each phase of the research (research problem, research question one and research question two). As soon as the “architectural framework” of the research process was clearly explained, the execution of the research could continue in the next chapter.

The results and discussions were completed in the Results and Discussions chapter. The results from the packaging evaluation model, interpreted in Chapter 2, showed that stackability, product remaining in packaging, and spout design were the three packaging criteria that scored the lowest and had to be change on either packaging design #2 or packaging design #1. Finally, a packaging redesign process was developed using content analysis coding. The content was also interpreted in Chapter 3. The goal of the redesign process was to emphasise the resources required to address the aforementioned three criteria. It was also established that a generic packaging design and development process was very difficult (if not impossible) to create.

In conclusion, from the problem statement, a primary question was derived stating whether there were indications of possible needs for new packaging design and development in order to improve packaging efficiency. Research question one and two were created in order to identify a packaging evaluation tool and packaging criteria that scored poorly and then seeing if a packaging-specific development process or generic development process could be developed theoretically. The evaluation tool identified was the packaging scorecard. The packaging development process was developed for redesigning the spout design on packaging design #2 which in turn affects the stackability and product remaining in packaging criteria while considering the environmental sustainability of the redesigned packaging.

To complete the entire research process, the deductions made from the literature suggested that integration between packaging and product (PPS) should be done early in product and packaging design and development stages (if the product will be developed). Sustainable development should also be done on an intermediate level of concern to increase efficiency and effectiveness of product and packaging development, which can be market-pulled and focusing specifically on the environmental factor of sustainability. The entire research process is depicted in *Figure 6.1*.

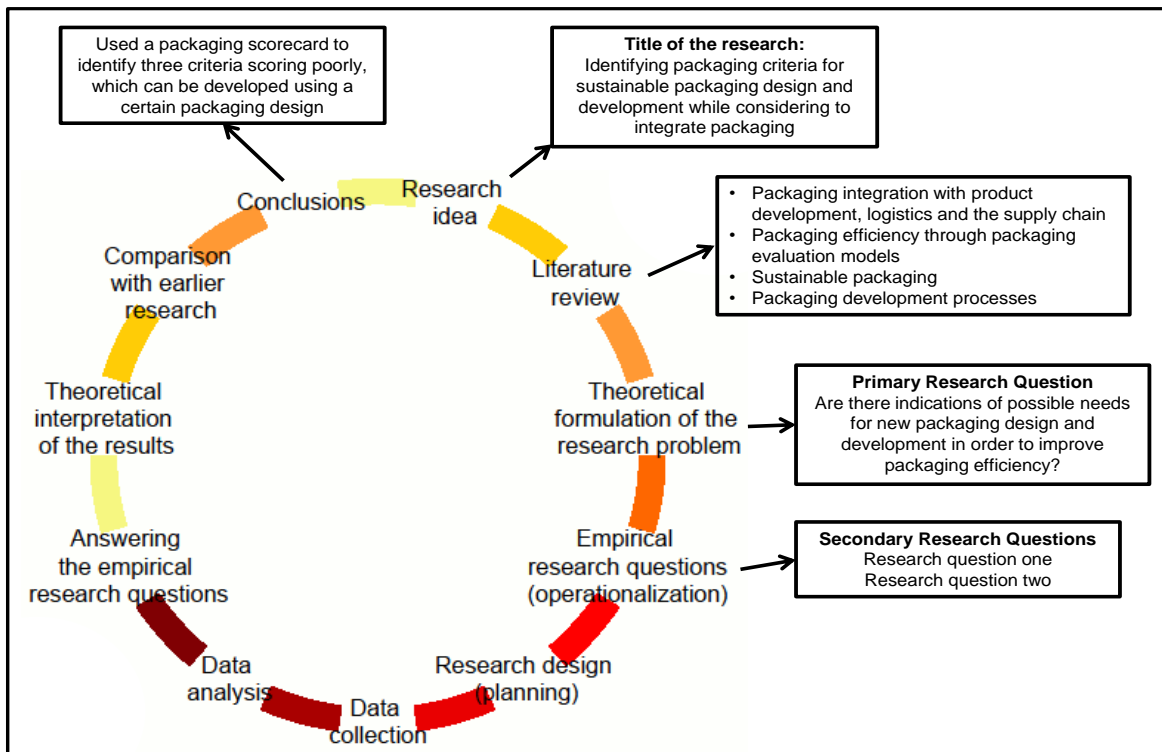


Figure 6.1: Completing the research process

Source: (SCMS Library, n.d.)

Research question one:

By making use of a certain packaging evaluation model, which packaging criteria (that affect packaging efficiency) should be improved by analysing different aseptic carton designs in the South African market?

“The packaging evaluation tool” is the packaging scorecard. The “packaging criteria” are stackability, spout design, and product remaining in packaging (each affecting packaging efficiency and sustainability). “Different aseptic carton designs” are the seven different designs analysed.

Research question two:

Which theoretical packaging development process can be presented in order to develop the packaging in terms of the criteria identified in question one and is it possible for the process to be a generic development process?

“Theoretical packaging development process” is the process created via content analysis coding. Furthermore, according to the literature and content analysis, it is not “possible for the process to be generic development process.”

Primary Research Question:

Are there indications of possible needs for new packaging design and development in order to improve packaging efficiency?

The final answer to this primary research question is yes, there are indications towards the need of designing and developing a packaging solution for the fruit juice market in South Africa in order to improve packaging efficiency.

Chapter 7: Recommendations for Future Research

The contribution this research makes is that if a problem is identified in a packaging design, either packaging managers, design managers, the research and development teams, or packaging manufacturers could consider doing the following: identify the three (or more) criteria that should be changed using the packaging scorecard, use the redesign process as a guideline to change the packaging design, and see if the redesign improves the packaging design.

This study described a holistic methodology for packaging designers and developers. The methodology has been developed to be of assistance to packaging designers to evaluate the current packaging designs and to be able to develop solutions to the packaging criteria using the proposed packaging development process. Now that the analysis has been concluded and the results have been identified, the final conclusions and recommendations for future research can be made.

7.1. Difficult to incorporate Design Process

Since there are different requirements for various packaging and products, packaging producers may find it difficult to integrate changes made to a packaging system. The reason for this is the complexity of integrating the new packaging design into production and filling machines. The process is expensive and time-consuming (Klevås, 2013). Furthermore, since the combination of identification and development is between cross-functional teams, it is difficult to assume implementation for all packaging types is plausible (Svanes *et al.*, 2010).

7.2. Shifting focus across Packaging Levels

There were many design-related issues regarding the change of the current packaging design of the 1-litre aseptic carton used in the fruit juice industry. Some of these issues could have been avoided and the focus could have been shifted instead to the secondary packaging, and not the primary packaging. According to Sohrabpour *et al.* (2012), when compared to primary packaging, secondary packaging can be easily changed or modified in the supply chain environment so that it can adhere to the relevant packaging requirements. Some of

these improved secondary packaging levels include designs like the Rapid Packaging Container.

7.3. Outsourcing Design Process

Another factor identified in this study is that packaging design does not necessarily have to be done internally or outsourced by a third-party company. A new design technique for new packaging could be implemented through “crowdsourcing”. Crowdsourcing is the process of getting work (or funding) online from a crowd of people (Crowdsourcing.org, 2015). The goal is to outsource micro tasks, which are tasks that computers are not always capable of doing. The buyers, which are in need of a new design for logos, packaging, or products, proposes a project online. Within a limited time, the individual/community, registered as the designer/developer, has to deliver final projects with personal funding. The buyer chooses the best design that suits the relevant project and pays the individual/community for the designs. However, some may argue that crowdsourcing or crowdfunding may be interest-driven and ignores the risks (Crowdsourcing.org, 2015). That said, this process saves much more on internal operating costs and may even result in better solutions.

7.4. Differences in Terminology

In the literature relevant to this study, it was found that most authors describe mostly the same thing but by making use of different terminology. Bramklev (2007) encountered the same problem. For example, the packaging as an object was referred to as “packaging” or “package” or even “a pack” by different authors. However, since most of the packaging industry consists of separate entities and has evolved into different routes over the years, it is obvious that most of the terminology could differ (Bramklev, 2007). Regarding the language and terminology found throughout conducting this research, it was found that there were not consistent general terminologies present. In general, it is advantageous to work on a universal set of terminology that can be recognised anywhere in the world. The smartphone industry is a very good example. By making use of words like “application” that are globally recognised by the target group that uses the smartphones, it simplifies the language in which the role players can communicate. There should be a globalised terminology for the phases within the packaging development process. Making use of the SCOR or DCOR reference models to

update the terminology relevant to a packaging development process should be considered. The Design Chain Operational Reference (DCOR) is a reference model that aims to apply the major process components of the framework (Plan, Research, Design, Integrate, Amend, and Enable) to a product and process design perspective (Supply Chain Council, 2012). These components can be used to model design chains, identify and choose key design chain performance indicators, and select best practices for use in benchmarking and performance improvement of a new product design (Supply Chain Council, 2012).

7.5. Integrating product and packaging development

It can also be beneficial to combine the packaging development process with the product development process. This can increase the efficiency and effectiveness of the packaging system as well as reduce the time and resources necessary for both of these processes (Bramklev, 2007).

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Appendix A: Damaged and crumpled tops of 1-litre cartons



Appendix B: Online Questionnaire Results

Question 1: I am satisfied with the current designs.

	Design 1	Design 2	Average	Combined
Fully Disagree	9.3%	16.3%	25.6%	46.5%
Disagree	23.3%	44.2%	67.4%	
Agree	30.2%	32.6%	62.8%	53.5%
Fully Agree	37.2%	7%	44.2%	

As illustrated, 46.5% of the respondents disagreed and fully disagreed with the statement for one of the packaging designs. However, the majority of respondents (53.5%) is satisfied or fully satisfied with the current designs.

Question 2: The spout causes a mess, splash or spill when I pour the content.

	Design 1	Design 2	Average	Combined
Fully Disagree	16.3%	0.0%	16.3%	38.4%
Disagree	41.9%	18.6%	60.5%	
Agree	23.3%	41.9%	65.1%	61.6%
Fully Agree	18.6%	39.5%	58.1%	

The majority of respondents (61.6%) agrees or strongly agrees that the spout on the packaging designs causes a mess, splash or spills when the content is poured.

Question 3: I struggle to break the seal of the spout.

	Design 1	Design 2	Average	Combined
Fully Disagree	37.2%	4.7%	41.9%	37.2%
Disagree	20.9%	11.6%	32.6%	
Agree	18.6%	37.2%	55.8%	62.8%
Fully Agree	23.3%	46.5%	69.8%	

The majority of respondents (62.8%) agrees or strongly agrees that they struggle to break the seal from the packaging design. In total, more respondents feel that they can break the seal one packaging design easier than the other. There is a design difference in the two seals. There are seals available in the market that breaks automatically as soon as the consumer

opens it for the first time. This feature facilitates ease of opening the spout, which may affect the consumer experience.

Question 4: I feel the design is satisfactory.

	Design 1	Design 2	Average	Combined
Fully Disagree	7.0%	16.3%	23.3%	51.2%
Disagree	30.2%	48.8%	79.1%	
Agree	39.5%	34.9%	74.4%	48.8%
Fully Agree	23.3%	0.0%	23.3%	

The results from question four are almost evenly spread with 51.2% of the respondents that disagree or fully disagree that the packaging designs are satisfactory. It can be argued that the question is the same as the first question and seem redundant; however, repeating a question allows the researcher to analyse the validity of the quality of the responses (Jackson, 2011). It can therefore be concluded that there are respondents that are not fully satisfied with the carton design.

Question 5: I feel I waste some of the product when I dispose of the carton.

	Design 1	Design 2	Average	Combined
Fully Disagree	23.3%	16.3%	39.5%	48.8%
Disagree	25.6%	32.6%	58.1%	
Agree	27.9%	30.2%	58.1%	51.2%
Fully Agree	23.3%	20.9%	44.2%	

The majority of respondents (51.2%) agrees or fully agrees that they feel some of the content is left inside the carton when disposing the packaging. This may indicate a flaw in the packaging design and further analysis could be justified.

Question 6: I have to clean up after pouring the contents.

	Design 1	Design 2	Average	Combined
Fully Disagree	18.6%	2.3%	20.9%	40.7%
Disagree	37.2%	23.3%	60.5%	
Agree	32.6%	55.8%	88.4%	59.3%
Fully Agree	11.6%	18.6%	30.2%	

The majority (59.3%) of the respondents agrees that cleaning up after pouring the content is necessary in the case of both packaging designs. The results are almost similar compared to question five, indicating a flaw in the packaging designs, especially the spout designs.

Question 7: I consume the product directly from the carton.

	Design 1	Design 2	Average	Combined
Fully Disagree	46.5%	53.5%	100.0%	67.4%
Disagree	11.6%	23.3%	34.9%	
Agree	30.2%	14.0%	44.2%	32.6%
Fully Agree	11.6%	9.3%	20.9%	

As illustrated, the majority of respondents (67.4%) do not consume the product directly from the carton. Therefore, it might not be an important design specification when considering making changes to the packaging design or specifically the spout design.

Question 8: *Which design do you prefer?* Lastly, the respondents were asked which packaging design they prefer. The results show that 51.16% of the respondents prefer the one packaging design where only 6.98% of the respondents prefer the other. However, 41.86% of the respondents would prefer a different design over the two designs used in the questionnaire. This ultimately means that almost 42% of consumers do not like the packaging designs used and would prefer a different design.

Appendix C: Packaging Criteria identified by Olsmats and Dominic (2003).

Criteria for the Packaging Scorecard				
Criteria	Supplier	Transportation, distribution and wholesale	Retail	Consumer
Machinability	X			
Product protection	X	X	X	X
Flow information	X	X	X	
Volume and weight efficiency	X	X	X	
Right amount and size		X	X	X
Handleability		X	X	X
Other value-adding properties	X			X
Product information				X
Selling capability			X	X
Safety			X	
Reduced use of resources	X			
Minimal use of hazardous substance	X			X
Minimal amount of waste			X	X
Packaging costs	X			
Stackability	X	X	X	X
Spout Design				X

Appendix D: The online questionnaire


page 1

1-Litre Fruit Juice Carton Survey

There are 2 different designs (Twist-Top and the Flip-Top)
Choose 1 answer for each design

* Required

Twist-Top on left and Flip-Top on the right



The image shows two 1-litre fruit juice cartons side-by-side. The carton on the left is yellow and orange, featuring the 'Liqui Fruit' logo and '100% ORANGE' text. The carton on the right is green and orange, featuring the 'Purejoy' logo and 'Orange 100% FRUIT JUICE BLEND' text.

State/Province

ZIP/Postal Code *

Country *

I am satisfied with the current design

1 = Disagree, 4 = Agree

	1	2	3	4
Twist-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flip-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

The spout causes a mess, splash or spill when I pour the content

1 = Disagree, 4 = Agree

	1	2	3	4
Twist-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flip-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I struggle to break the seal of the spout

1 = Disagree, 4 = Agree

	1	2	3	4
Twist-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flip-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I feel the design is satisfactory

1 = Disagree, 4 = Agree

	1	2	3	4
Twist-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flip-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I feel I waste some of the product when I dispose of the carton

1 = Disagree, 4 = Agree

	1	2	3	4
Twist-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flip-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I have to clean up after pouring the contents

1 = Disagree, 4 = Agree

	1	2	3	4
Twist-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flip-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I consume the product directly from the carton

1 = Disagree, 4 = Agree

	1	2	3	4
Twist-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Flip-Top	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Which design do you prefer?

I would prefer...

Additional comments for Twist-Top

Additional comments for Flip-Top

Appendix E: Adjusted Packaging Scorecard for the Six Different Packaging Designs completed by Retailers.

Step 1: Rate each relevant criterion, where 0 means not relevant and 100 means very important. Compare each criterion to each other. Step 2: Evaluate packaging performance where; 0, not applicable for the package, 1 not approved, 2 approved, 3 well approved, 4 met excellently							
Criteria	Weight (0-100%)	Score (0-4)					
		1 Packaging Design #1	2 Packaging Design #2	3 Packaging Design #3	4 Packaging Design #4	5 Packaging Design #5	6 Packaging Design #6
Product Protection <i>Ability to protect the product and preventing the product from reacting with the external environment.</i>							
Flow Information <i>Capability to give the information that is logistics related.</i>							
Volume and Weight Efficiency <i>Ability to make use of all the available volume and load capacities.</i>							
Right amount and size <i>Packaging adapted to consumption rate (1000ml)</i>							
Handleability <i>The ability to facilitate handling (make it easier to fill, store, transport, lift, close, empty etc)</i>							
Selling Capabilities <i>Ability to sell and advertise the product to the end-user</i>							
Safety <i>Ability to protect the product from shoplifters.</i>							
Minimal Use of Hazardous Substances <i>Amount of hazardous substances in the packaging material is kept to the minimum</i>							
Stackability <i>Ability to stack many shipment units as possible in warehouse, during shipping, retailer shelves and consumer's storage</i>							
Unwrapping <i>Easy to remove unnecessary packaging material</i>							
Spout Design <i>Ease of opening the spout, pouring the content and closing the spout.</i>							

Appendix F: Adjusted Packaging Scorecard for the Seven Different Packaging Designs completed by the Consumers.

Step 1: Rate each relevant criterion, where **0** means not relevant and **100** means very important. Compare each criterion to each other.
Step 2: Evaluate packaging performance where; **0**, not applicable for the package, **1** not approved, **2** approved, **3** well approved, **4** met excellently

Criteria	Weight (0-100%)	Score (0-4)						
		1	2	3	4	5	6	7
		Packaging Design #1	Packaging Design #2	Packaging Design #3	Packaging Design #4	Packaging Design #5	Packaging Design #6	Packaging Design #7
Product Protection <small>Ability to protect the product and preventing the product from reacting with the external environment</small>								
Right amount and size <small>Packaging adapted to consumption rate (1000ml)</small>								
Carton Design <small>Size, shape and design of packaging in terms of appearance</small>								
Handleability <small>The ability to facilitate handling (make it easier to fill, store, transport, lift, close, empty etc)</small>								
Product Information <small>The ability to display product information to inform and promote the product</small>								
Selling Capabilities <small>Ability to sell and advertise the product to the end-user</small>								
Minimal Use of Hazardous Substances <small>Amount of hazardous substances in the packaging material is kept to the minimum</small>								
Stackability <small>Ability to stack many shipment units as possible in warehouse, during shipping, retailer shelves and consumer's storage</small>								
Unwrapping <small>Easy to remove unnecessary packaging material</small>								
Spout Design <small>Ease of opening the spout, pouring the content and closing the spout</small>								
Product Remaining in Packaging <small>Amount of product(s) remaining in the packaging that you are unable to consume</small>								
Minimal Amount of Waste <small>Waste from the packaging after disposing it</small>								

Appendix G: Structured Interview Questions with the Product Manufacturer.

Interview Questions with product manufacturers concerning Retailers/Wholesalers/Distributors

1. How do the 1-litre cartons of juice arrive?
2. From who does the 1-litre cartons arrive?
3. How are they packed when they arrive? (Secondary + Tertiary)
4. How do you unload and handle each component delivered to you?
5. How and where do you store the boxes?
6. How much box or plastic waste do you have? (Secondary + Tertiary)
7. What do you do with the waste?
8. Do you have damaged goods on arrival? Who is liable for the damages?
9. Do you damage some of the products when packing? Who is liable for the damages?
10. Which Logistics service provider distributes the product?
11. What are your steps and procedures for a new product packaging development?
12. What are the strengths of this packaging design?
13. What are the weaknesses of this packaging design?
14. Where do you think can be an improvement in the packaging design?

Appendix H: Letter of Consent for the Information gathered from the Key Role Players.

I, _____, hereby give Jacques van der Berg,
Masters Student at Stellenbosch University, consent to make
use of the data given to him in his research which will be
written up in an aggregate format in his thesis.

Date _____

Signed at _____

Signature _____

Jacques van der Berg _____

Appendix I: First Phase Results of the Content Analysis Coding

Field	Author	Word/Phrase	Position	Count	Category	Label
Product Manufacturer	Volmink, B. (2015)	Project Proposal	1	1	ideas funnel	Decision-making
Product Manufacturer	Volmink, B. (2015)	Development	2	4	ideas funnel	Decision-making
Product Manufacturer	Volmink, B. (2015)	Pre-production	3	1	ideas funnel	Decision-making
Product Manufacturer	Volmink, B. (2015)	Launch	4	4	ideas funnel	Decision-making
Product Manufacturer	Volmink, B. (2015)	Post-launch Review	5	1	ideas funnel	Decision-making
Product Manufacturer	Volmink, B. (2015)	Ideas	1	1	PDP	Phase
Product Manufacturer	Volmink, B. (2015)	Feasibility	2	1	PDP	Phase
Product Manufacturer	Volmink, B. (2015)	Capability	3	1	PDP	Phase
Product Manufacturer	Volmink, B. (2015)	Development	4	4	PDP	Phase
Product Manufacturer	Volmink, B. (2015)	Production	5	5	PDP	Phase
Product Manufacturer	Volmink, B. (2015)	Launch	6	4	PDP	Phase
Academic	Briston & Neill (1972)	Planning	1	6	PDP	Phase
Academic	Briston & Neill (1972)	Design	2	8	PDP	Phase
Academic	Briston & Neill (1972)	Graphic Design	3	4	PDP	Phase
Academic	Briston & Neill (1972)	Sales Administration	4	1	PDP	Phase
Academic	Griffin, Sacharow & Brody (1985)	Planning	1	6	PDP	Phase
Academic	Griffin, Sacharow & Brody (1985)	Concept	2	9	PDP	Phase
Academic	Griffin, Sacharow & Brody (1985)	Design	3	8	PDP	Phase
Academic	Griffin, Sacharow & Brody (1985)	Production Planning	4	3	PDP	Phase
Academic	Griffin, Sacharow & Brody (1985)	Total System	1	1	PDP	Path

Field	Author	Word/Phrase	Position	Count	Category	Label
Academic	Griffin, Sacharow & Brody (1985)	Package Development	2	1	PDP	Path
Academic	Frank A. Paine (1990)	Concept	1	9	PDP	Phase
Academic	Frank A. Paine (1990)	Design	2	8	PDP	Phase
Academic	Frank A. Paine (1990)	Production Planning	3	3	PDP	Phase
Academic	Soroka (1997)	Planning	1	6	PDP	Phase
Academic	Soroka (1997)	Concept	2	9	PDP	Phase
Academic	Soroka (1997)	Design	3	8	PDP	Phase
Academic	Soroka (1997)	Product Planning	4	1	PDP	Phase
Academic	DeMaria (2000)	Planning	1	6	PDP	Phase
Academic	DeMaria (2000)	Concept	2	9	PDP	Phase
Academic	DeMaria (2000)	Design	3	8	PDP	Phase
Academic	DeMaria (2000)	Production Planning	4	3	PDP	Phase
Academic	R. Klooster (2002)	Planning	1	6	PDP	Phase
Academic	R. Klooster (2002)	Concept	2	9	PDP	Phase
Academic	R. Klooster (2002)	Design	3	8	PDP	Phase
Academic	R. Klooster (2002)	Graphic Design	4	4	PDP	Phase
Academic	Bramklev (2007)	Planning	1	6	PDP	Phase
Academic	Bramklev (2007)	Development	2	4	PDP	Phase
Academic	Bramklev (2007)	Concept	3	9	PDP	Phase
Academic	Bramklev (2007)	Design	4	8	PDP	Phase
Academic	Bramklev (2007)	Production	5	5	PDP	Phase
Academic	Bramklev (2007)	Integration	6	1	PDP	Phase
Academic	Bramklev (2007)	Production	7	5	PDP	Phase
System	Stage-Gate®	Scoping	1	1	D	Gate

Field	Author	Word/Phrase	Position	Count	Category	Label
System	Stage-Gate®	Business Case	2	1	D	Gate
System	Stage-Gate®	Development	3	4	D	Gate
System	Stage-Gate®	Test	4	1	D	Gate
System	Stage-Gate®	Launch	5	4	D	Gate
Theory	C-K Theory	Knowledge	1	1	D	Space
Theory	C-K Theory	Concept	1	9	D	Space
Academic	Scheuneman	Packaging Requirements	1	2	PDP	Phase
Academic	Scheuneman	Product Needs	2	1	PDP	Phase
Academic	Scheuneman	Concept	3	1	PDP	Phase
Academic	Scheuneman	Regulations	4	1	PDP	Phase
Academic	Scheuneman	Production	5	5	PDP	Phase
Academic	Scheuneman	Distribution	6	1	PDP	Phase
Academic	Scheuneman	Customer Needs	7	1	PDP	Phase
Academic	Scheuneman	Recyclability	8	1	PDP	Phase
Academic	Collins (2015)	Packaging Requirements	1	2	PDP	Event
Academic	Collins (2015)	Concept	2	9	PDP	Event
Academic	Collins (2015)	Prototype	3	1	PDP	Event
Academic	Collins (2015)	Graphic Design	4	4	PDP	Event
Academic	Collins (2015)	Concept	5	9	PDP	Event
Academic	Collins (2015)	Production	6	5	PDP	Event
Academic	Collins (2015)	Design	7	8	PDP	Event
Academic	Collins (2015)	Graphic Design	8	4	PDP	Event
Academic	Collins (2015)	Performance Measures	9	1	PDP	Event
Academic	Collins (2015)	Launch	10	4	PDP	Event