

Packaging of table grapes for exports from SA: A comparative study

by

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ABSTRACT

Table grapes are the second-largest contributor to the perishable product export in South Africa. The table grape industry also experienced considerable growth in the past ten years. The industry contributes toward employment in South Africa. The South African table grape industry experiences quality-related problems with exporting table grapes to the European market. Examples of quality related problems can range from chemical damage, chilling injury/freezing damage, heavy bruising and decay. A great amount of table grapes is basically wasted. The postharvest loss of table grapes during transportation can range from 1%-25% per day depending on the degree of temperature fluctuation. Therefore, it is important to minimize waste and increase the export volumes in order to utilise the potential profit possibilities.

Based on data analysis for this case, results indicated that packaging is preventing cool air from flowing through the pallet during transportation and preventing the table grapes to cool evenly. The fluctuation in temperature contributes to the quality-related problems of these table grapes. The primary research goal is to identify packaging-related problems and propose possible solutions to improve the packaging-related conditions in which table grapes arrive at the destination. This study therefore investigated and evaluated the performance of the current packaging system of table grapes within a South African context for exporting to Europe for a specific case. Further analyses of the data received from Dole South Africa, a fruit marketing and distribution company, revealed that the following two types of packaging showed serious quality-related problems:

- 1) A04I: The 4.5kg box with the grapes in plastic bags.
- 2) A05E: The 5kg box with 500g punnets (10 x 500g punnets).

A questionnaire combining with the Packaging Portfolio Evaluation Model and the Packaging Scorecard was developed and used to evaluate the two identified packaging systems in the following stages:

Stage 1: Development of a new questionnaire by combining the Packaging Portfolio Evaluation Model and the Packaging Scorecard.

Stage 2: Survey with the questionnaire developed in Stage 1. The identified types of packaging were evaluated with a new questionnaire with specific criteria. Members of the table grape supply chain from the farmer in South Africa to consumer in Sweden were used during the evaluation process.

Descriptive statistics were calculated for each criteria or question in order to describe the performance and importance of the different packaging criteria. Data were also analysed with the use of box plots. The box plots and data visualisation methods were used to make conclusions and recommendations regarding the different categories of each type of packaging. It was clear that the major problem areas of both packaging systems involved were related to the environmental aspect of the packaging. The marketing and the logistics of the plastic bag also underperformed. However, individual criteria regarding the other business areas can also be improved. Possible solutions to these problem areas are also suggested in this thesis. The possible solutions include the Tali Grape Basket, Perforated Plastic Liners, New Generation Pack (NGP), Vanguard TM, Easypunnet and the Sulphur Dioxide Liner Bag.

OPSOMMING

Tafeldruiwe is die tweede grootste bydraende faktor tot bederfbare produkuitvoere in Suid-Afrika. Die tafeldruiwindustrie het ook aansienlike groei die afgelope tien jaar beleef. Die industrie dra tot werkskepping in Suid-Afrika by. Die Suid-Afrikaanse tafeldruiwindustrie ervaar kwaliteitsverwante probleme met die uitvoer van tafeldruiwe na die Europese mark. Voorbeelde van hierdie kwaliteitsverwante probleme kan wissel van chemiese skade, koueskade / vries skade, swaar kneusing en bederf. 'n Groot hoeveelheid tafeldruiwe word vermors. Die oes verlies van tafeldruiwe tydens vervoer kan wissel van 1% -25% per dag, afhangende van die mate van temperatuur verandering. Daarom is dit belangrik om vermorsing te beperk en uitvoerhoeveelhede te verhoog om sodoende potensiële winsmoontlikhede te benut.

Volgens data-analise blyk dit dat huidige verpakking tans verhoed dat koel lug tydens die vervoer van die produk deur die palet vloei, en dit veroorsaak dat die tafeldruiwe nie eweredig afkoel nie. Die wisseling in temperatuur dra grootliks tot die kwaliteitsverwante probleme van die tafeldruiwe by. Die primêre navorsingsdoelwit is om die verpakkingsverwante probleme te identifiseer en moontlike oplossings voor te stel om sodoende die toestand te verbeter waarin tafeldruiwe by die eindbestemming aankom. Daarom ondersoek en evalueer hierdie studie die prestasie van die huidige verpakkingsstelsel van tafeldruiwe binne 'n Suid-Afrikaanse konteks vir uitvoere na Europa; met betrekking tot 'n spesifieke situasie.

Verdere analise van data soos ontvang vanaf Dole Suid-Afrika, 'n vrugtebemarkings- en verspreidingsmaatskappy, het getoon dat ernstige kwaliteitsverwante probleme veral by die volgende twee tipes verpakkingsstelsels voorkom:

- 1) A04I: Die 4.5kg karton met druiwe in plastieksakkies.
- 2) A05E: Die 5kg karton met 500g bakkies (10 x 500g bakkies).

'n Vraelys, gebaseer op die kombinasie van die Verpakkingportefeulje Evalueringsmodel en die Verpakkingstelkaart, is ontwikkel en gebruik om die bogenoemde verpakkingsstelsels te evalueer en wel in die volgende fases:

Fase 1: Ontwikkeling van 'n gekombineerde Verpakkingportefeulje Evalueringsmodel en die Verpakkingstelkaart tot 'n nuwe vraelys.

Fase 2: Opname met die vraelys soos ontwikkel in Fase 1. Die twee geïdentifiseerde tipes verpakking is geëvalueer met die nuwe vraelys met spesifieke kriteria. Die lede van die tafeldruiwe voorsieningsketting van die boer in Suid-Afrika tot die verbruiker in Swede is gebruik tydens die evaluasieproses.

Beskrywende statistiek vir elke kriteria of vraag was bereken sodat die prestasie en belangrikheid van die verskillende verpakkingskriteria beskryf kan word. Data was ook beskryf met behulp van 'n houer-en-puntstipping. Data visualiseringmetodes en die houer-en-puntstippings was gebruik om gevolgtrekkings en aanbevelings rakende die verskillende kategorieë van die tipes verpakking te maak. Dit was duidelik dat die omgewingsaspek van beide tipes verpakking 'n groot probleem was. Die bemarking en logistiek van die plastieksakkie het ook onderpresteer. Individuele kriteria van ander besigheidsareas kan egter ook verbeter word. Moontlike oplossings vir hierdie probleem-areas word ook in hierdie tesis aangedui. Die moontlike oplossings sluit die "Tali Grape Basket", "Perforated Plastic Liners", "New Generation Pack (NGP)", "Vanguard TM", "Easypunnet" en die "Sulphur Dioxide Liner Bag" in.

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CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 INTROUDUCTION

South Africa is the oldest and most reliable supplier of table grapes to the Northern Hemisphere (SATI, 2010). Table grapes are the second-largest contributor to the perishable product export in South Africa (PPECB, 2012). Therefore, it plays an important role in terms of economic growth and development. Approximately 59.55% of the South African table grapes were destined for the European market during the last five seasons of 2010/11 as illustrated in Figure 1.1 (PPECB, 2012).

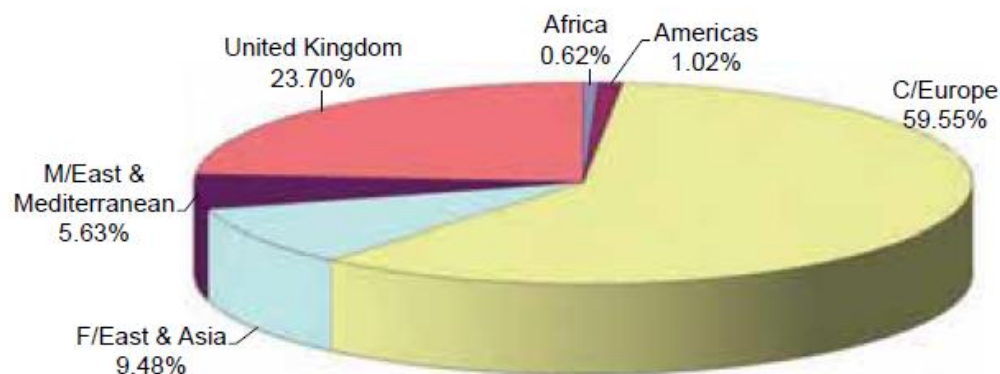


Figure 1.1: Major destinations of South African table grapes for the past five seasons (PPECB, 2012).

Most of the table grapes produced in South Africa are intended for the international market as indicated in Figure 1.2. A small amount of the table grapes produced in South Africa is sold in the local market.

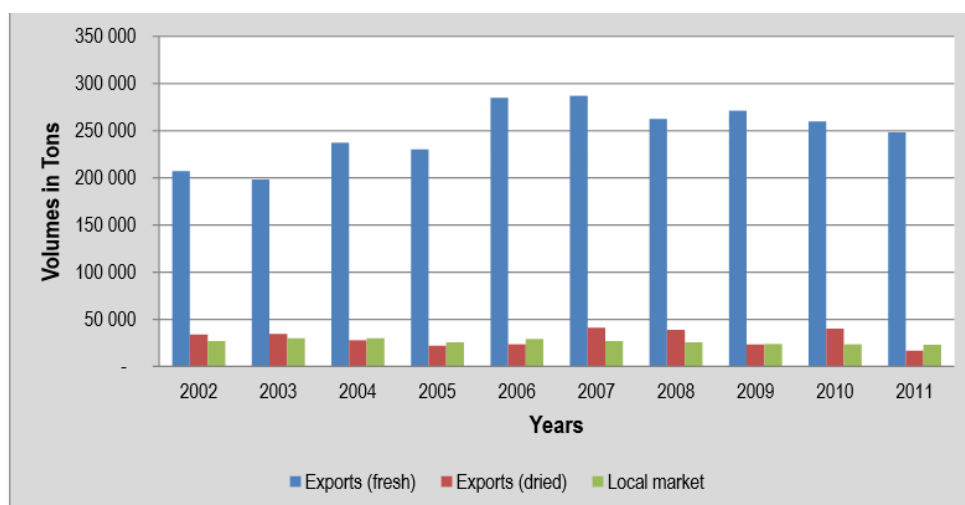


Figure 1.2: The distribution of table grapes according to markets (SATI, 2011).

The table grape industry experienced growth in the past ten years (Reynolds 2009). The linear trend line in Figure 1.3 indicates a general growth in the export volumes of grapes in South Africa during 2000/01 – 2012/13 (Department of Agriculture, 2014).

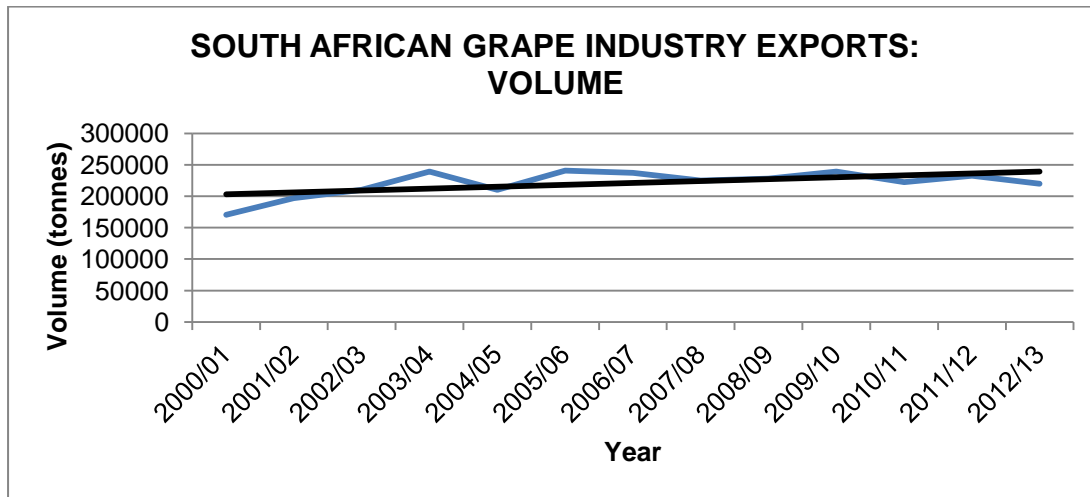


Figure 1.3: South African Grape Industry Export Volumes 2000 – 2013 (Department of Agriculture, 2014).

A problem that is currently experienced in South Africa is the poor condition of table grapes upon arrival when predominantly exported in reefer containers from South Africa to other countries. There is a possibility that existing packaging solutions are preventing effective ventilation, which could therefore have a negative effect on the quality levels of table grapes (Connell, 2012). According to Connell (2012) packaging has basically been the same for years and can be improved in order to meet the requirements for the above mentioned method of transport.

A large amount of table grapes is essentially wasted (Clarke, 2012). The postharvest loss of table grapes during transportation can range from 1%-25% per day depending on the degree of temperature fluctuation (Kader, A.A. & Rolle, R.S. 2004). Therefore, it is important to minimize waste and increase the export volumes in order to utilise the potential profit possibilities. Consequently, it will have a positive effect on the South African economic growth and development in an already unstable global economy.

1.2 BACKGROUND

Dole South Africa is one of the leading fruit marketing and distribution companies in South Africa (Connell, 2012). According to Connell (2012) the company has one of the best supply chain traceability rates in South Africa.

Dole South Africa has a commitment towards economic growth and development (Dole South Africa, 2012). Table 1.1 indicates the percentage of farm workers employed in agriculture during 2008 – 2013 (Department of Agriculture, 2014). It is therefore evident that agriculture contributes towards a relatively large and relatively constant percentage of employment in South Africa with 6.34% in 2008, 5.24% in 2009, 5.52% in 2010, 5.14% in 2011, 5.34% in 2012 and 5.37% in 2013. With the partnership of more than 200 independent growers and the contracted orchards, vineyards and pack houses that employ thousands of people, Dole South Africa makes a contribution towards the abovementioned employment figures (Dole South Africa, 2012). It is therefore important to promote and improve the South African Table Grape Industry as it plays an important role in the South African economy.

Table 1.1: Employment percentage in the agriculture sector from 2008 - 2013 (Department of Agriculture, 2014).

Number of workers	2008	2009	2010	2011	2012	2013
	(‘000)	(‘000)	(‘000)	(‘000)	(‘000)	(‘000)
Workers in agriculture, hunting, forestry and fishing	866	725	716	685	728	807
Total employment*	13 655	13 844	12 975	13 318	13 645	15 036
Percentage (%) of employment in the agriculture sector	6.34%	5.24%	5.52%	5.14%	5.34%	5.37%

**Total employment refers to all employment in all sectors*

However, Dole South Africa is currently experiencing problems in terms of the packaging and transportation of table grapes in reefer containers. According to Connell (2012) there is little innovation in terms of packaging for South African grape exports. Currently 90% of fruit is exported in containers, and packaging has not been adapted to accommodate this predominant means of transport (Connell, 2012). With the large impact that the table grape industry has on the South African economy, it is very important to address these problems in order to improve the effectiveness and the efficiency of the table grape supply chain. Further research in this regard is therefore essential to address the source of the transport and packaging related problems experienced in the table grape industry.

CHAPTER 2: RESEARCH APPROACH

This Chapter outlines the different stages of the research process in this study. The research methods used at each stage are explained. All correspondence to gain insight and information with the relevant parties are also documented in this Chapter.

Research is regarded as a systematic process of collecting and analysing data in order to increase the understanding of a certain subject (Leedy & Ormrod, 2009:2). The exploratory research approach was conducted in order to obtain a better understanding of the situation or problem through the collection of information (Etchegaray, 2013). Exploratory research assists in identifying the problem areas. Figure 2.1 illustrates the research process adapted from Churchill & Lacobucci (2009:33). This approach assisted to determine the research process to be undertaken in this study.

2.1 RESEARCH PROCESS

Primary research is the collection of data that has not previously existed and it is mainly used to answer specific questions regarding the study (Zikmund & Babin, 2010:134). Primary research can be further divided into qualitative research (in-depth information) and quantitative research (numerical data are used to obtain information) (Zikmund & Babin, 2010:134).

Different methods of quantitative and qualitative research were used throughout the different phases of the research process as shown in Figure 2.1. Therefore, the hybrid method (a combination of quantitative research and qualitative research) was used in this study in order to ensure a successful outcome (Zikmund & Babin, 2010:134).

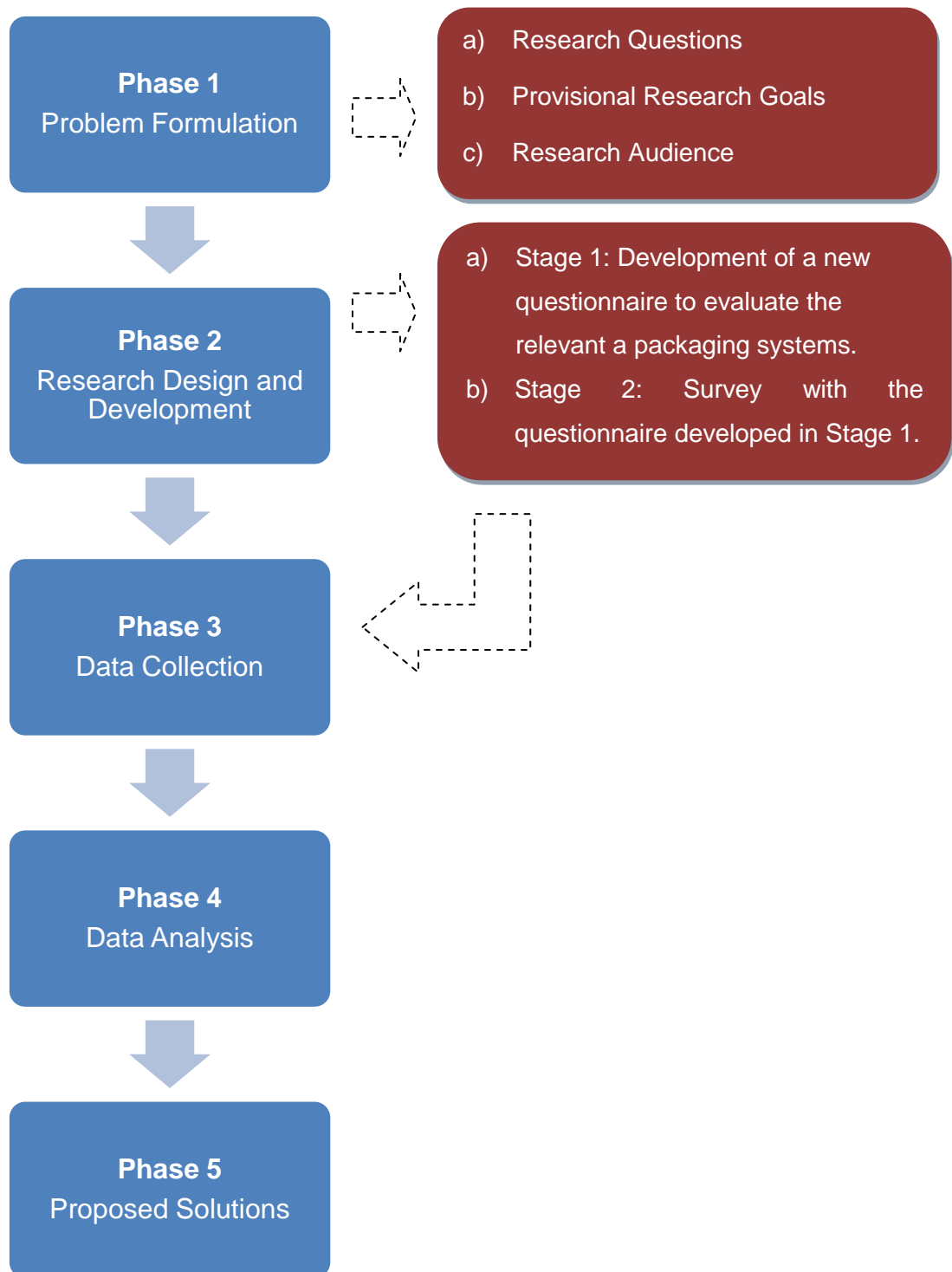


Figure 2.1: Research Process (Churchill & Lacobucci, 2009:33)

2.1.1 PHASE 1: PROBLEM FORMULATION

Discussions were held and open-ended questions were asked to address more specific issues (Zikmund & Babin, 2010:191). These sessions provided the insight needed to identify and address concerns and problems (Young, 2004).

Two initial discussions held at Dole South Africa during January 2012 with Mr Connell, Business Manager: Logistics. This indicated that there are often incidences of problems with the condition of exported table grapes. These discussions provided the basis for the problem formulation.

Dole South Africa investigated possible causes in container shipping when poor condition in the table grapes was presented. The temperature of the table grapes shows a slight increase after having been loaded into the container (Connell, 2012). According to Connell (2012) other fruit that is handled by the same role players in the same supply chain does not seem to have the same problem.

After having collected more information, Dole South Africa suspects that the packaging of the table grapes may be a contributing factor which is preventing cool air to flow through the pallet and therefore not allowing the table grapes to cool evenly (Connell, 2012). According to Connell (2012) pressure from the market in terms of consumer preferences and costs make it difficult to change packaging. This market pressure also has a negative impact on the strength of packaging. Consumers do not want to pay more for the final product; therefore, producers tend to reduce the cost by using lower quality packaging.

Therefore, this study will investigate and evaluate the performance of the current packaging system of table grapes within a South African context for exporting to Europe.

2.1.1.1 RESEARCH QUESTIONS

Overarching research question:

What is the current performance of South African table grape packaging for exporting to Europe?

Sub-research questions:

What are the packaging related problems in the South African table grape industry for exporting to Europe? What are the possible solutions for the packaging related problems in the South African table grape industry?

2.1.1.2 PROVISIONAL RESEARCH GOALS

Primary goals:

- a) Identify the current performance of certain South African table grape packaging for exporting to Europe as perceived by the different role players within the supply chain.
- b) Identify the current importance of certain South African table grape packaging for exporting to Europe as perceived by the different role players within the supply chain.
- c) Identify possible steps to improve the packaging-related conditions in which table grapes arrive at the destination.

2.1.1.3 RESEARCH AUDIENCE

Due to the nature of this study, the findings of the research can primarily be used by the parties involved in this study. However, the findings can also be used by participants in the fruit export industry. The research can also be a foundation for further research in this relevant academic field.

2.1.2 PHASE 2: RESEARCH DESIGN AND DEVELOPMENT

- a) Stage 1: Development of a questionnaire to evaluate the relevant packaging systems.

The questionnaire developed formed the basis for the collection of primary data used in this study. This new questionnaire that was developed will be discussed further in Chapter 5.

- b) Stage 2: Survey with the questionnaire developed in Stage 1.

The primary research design used in this study is a single-case study method. This is when data from an instance are collected in order to accomplish the research objective (Dul & Hak, 2008:4). As mentioned above, the data were collected with the packaging questionnaire that was developed in Stage 1.

A comparative study research method was used in order to find possible solutions following the data analysis. This method is used to evaluate events, to obtain a better understanding and to make certain conclusions regarding the relationship of the events (Eisenhardt, 1989).

2.1.3 PHASE 3: DATA COLLECTION

Dole South Africa (Connell, 2012) and Saba Fruit Sweden (Bjelm, 2013) played a significant role in terms of data collection and support. Primary data were collected from the relevant role players in the table grape supply chain from South Africa to Sweden. This will be discussed further in Paragraph 5.2. The process used to collect this data will be discussed in more detail in Paragraph 2.1.3.1 and Paragraph 2.1.3.2.

2.1.3.1 DATA EXPLORATION

Further discussions held at Dole South Africa (Connell, 2012) in March 2012 provided an understanding of the current problems that they are experiencing concerning the export of table grapes. As discussed, data regarding the quality of table grapes during 2010 – 2012 of the complete supply chain were received from Dole South Africa after this meeting.

Discussions with Prof. Opara (Opara, 2012) in June 2012 were conducted in order to acquire a better understanding and insight into the interaction of table grapes with certain types of packaging under transportation conditions.

Observation is the documentation of observed events or objects (Zikmund & Babin, 2010:191). Observation of packaging is critical in uncovering ideas or opportunities for packaging innovation (Young, 2004). Observation during the industry visits at Saba Fruit in Sweden during December 2012 proved helpful towards developing additional packaging requirements criteria that are necessary during the packaging evaluation process.

Saba Fruit is a subsidiary of Dole Food Company Incorporated and distributes fruit and vegetables to wholesalers within Sweden (Saba Sweden, 2013). This visit also gave insight regarding the supply chain of the importing country. This provided the opportunity to observe and have discussions with all the role players in the supply chain, from South Africa to Sweden.

The data received from Dole South Africa were used to determine the types of table grape packaging that have a significant amount of quality-related problems during transportation.

The data visualisation program, Tableau Desktop (2013), will be used to visualise the data regarding the quality of table grapes throughout the supply chain. This data were received from Dole South Africa and will be used to determine the types of table grape packaging that have a significant amount of quality-related problems during transportation. Initial analysis of the different types of table grape packaging was performed to identify which packaging types to focus on. Figure 2.2 illustrates the level of quality problems (Q), measured in units of one thousand (K) against the type of packaging.

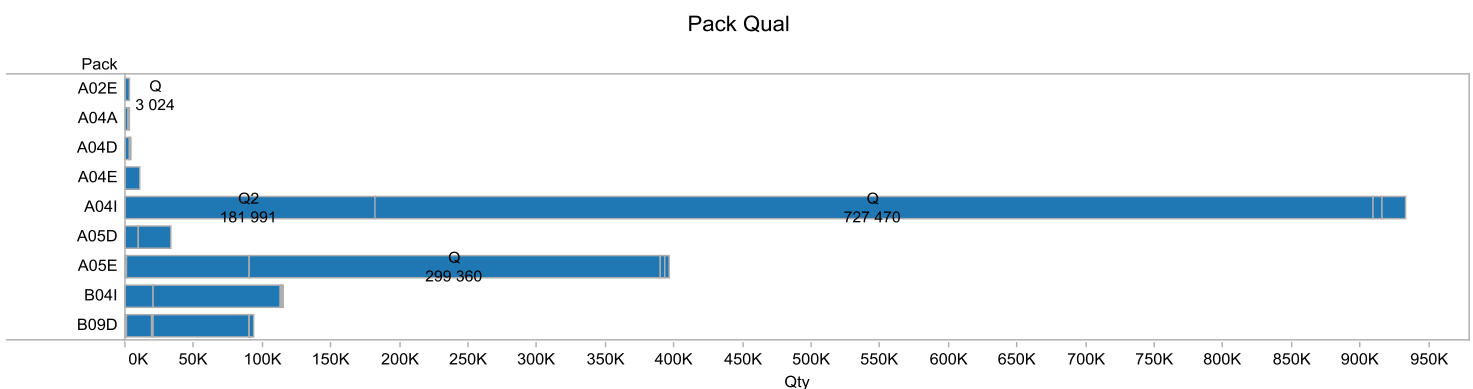


Figure 2.2: Table grape quality problems and packaging used.

The quality related problems (Q_1 , Q_2) range from physical and chemical damage to the fruit, physical damage to the packaging and incorrect packaging. The complete list of possible quality related problems which can occur is listed in Table 2.1.

Table 2.1: Possible quality related problems.

Q, Q1 AND Q2 QUALITY RELATED PROBLEMS	
Blocked/Rejected	Low pressure
Decay	Low Brix
Sour rot	Sizing (mix/under/over)
Blackspot (non-sensitive)	Poor colour
Alternaria	Mixed colour
Residue problem	Blush
Sum of total defects	Yellow
Sum of condition defects	Sunburn
Sum of cosmetic defects	Internal browning
Chilling injury / Freezing damage	Internal breakdown
Condensation	Chocolate berries
Incorrect markings	Bluegreen
Incorrect packaging material	Skin condition
Damaged pallets/cartons	Scald
Underweight	Bitterpit
Low bag count	Lenticellosis
Wax	SO ₂ burn/damage
Insects	Mechanical damage
Overmature	Splits/crush
Immature	Slipskin
Shatter	Wilted stems
Soft/wilting	Heavy bruising/rubmarks
Chemical damage	Heavy shrivel
Blemishes/Windmarks	Russeting

There are two types of packaging (A04I and A05E) with higher volumes of quality related problems in comparison with the other types of packaging. The A04I showed 932 763 - quality related problems and the A05E showed 396 555 - quality related problems as indicated in Figure 2.2. This indicates high levels of quality related problems (Q_i) during transportation as illustrated in Figure 2.2. The other types of packaging have significantly lower levels of quality related problems (Q_i). The other types of packaging are as follows:

- A02E: 1.5 kg loose.
- A02F: 1.5 kg loose.

- B04I: 4.g kg loose.
- B10D: 10 kg loose.
- A04A: 10 x 400g punnets.
- B09D: 9 kg loosely packed in an open carton.
- A05D: 5kg (10 x 500g punnets).

It is essential for the study to investigate these two types of packaging early in the research process as the rest of the research will focus solely on these two types of packing. This will ensure the rest of the research done in this study to be more accurate and relevant to the specific topic. This will ensure findings that is very likely to have a large impact when changes are implemented.

The two types of packaging are as follows:

- 1) A04I: The 4.5kg box with the grapes in plastic bags as indicated in Figure 2.3. The table grapes are placed in smaller plastic bags and then packaged in the 4.5kg box with plastic lining.



Figure 2.3: The 4.5kg box with the grapes in plastic bags (Connell, 2012) .

2) A05E: The 5kg box with 500g punnets (10 x 500g punnets) as indicated in Figure 2.4. The table grapes are placed in 500g plastic punnets and then packaged in the 5kg box with plastic lining (10 x 500g punnets).



Figure 2.4: The 5kg box with 500g punnets (Connell, 2012) .

2.1.3.2 SURVEYS

Surveys are the collection of primary data through questions and answers (Zikmund & Babin, 2010:191). Although surveys are less diagnostic they are essential to obtain more credibility (Young, 2004).

For the evaluation of the packaging system in this study, a new questionnaire was created. As mentioned in Paragraph 2.1.2 a questionnaire was developed during Stage 1 that formed the basis to collect primary data during Stage 2. The new questionnaire was created by combining the packaging scorecard and the packaging portfolio evaluation model and adding certain relevant criteria.

In order to get a more holistic approach to the contribution of packaging to the efficiency of the supply chain, a systematic survey evaluation method, the Packaging Scorecard, was developed (Olsmats & Dominic, 2003). The Packaging Portfolio Evaluation Model is also a survey evaluation method used to evaluate the packaging portfolio and indicates the potential for improvement in terms of each logistical area (Nilsson, Fagerlund & Körner, 2013). This new questionnaire that was developed will be discussed further in Chapter 5.

2.1.4 PHASE 4: DATA ANALYSIS

Data were collected from the new questionnaire developed during Stage 1 as mentioned in Paragraph 2.1.2. The questionnaires were completed by the relevant role players in the supply chain as discussed in Chapter 5.

Descriptive statistics were calculated for each criteria or question in order to describe the performance and importance of the different packaging criteria. These results were used to make conclusions and recommendations regarding the different categories of each type of packaging.

Data were also analysed with the use of box plots. Box plots are used to visualise data with the use of quartiles (Keller, 2009:118). The first quartile (Q_1) is equal to the 25th percentile, the second quartile (Q_2) is equal to the 50th percentile and the third quartile (Q_3) is equal to the 75th percentile (Keller, 2009:118). The interquartile range ($Q_3 - Q_1$) is used to create a measure of variability (Keller, 2009:120). The lines to the left and right are referred to as whiskers (Keller, 2009:121). The whiskers extend outward from Q_1 and Q_3 to the smaller of 1.5 times the interquartile range or to the most extreme point that is not an outlier (Keller, 2009:121). Outliers are unusual observations and should possibly be inspected (Keller, 2009:121). Outliers are beyond the whiskers (Keller, 2009:121).

2.1.5 PHASE 5: PROPOSED SOLUTIONS

As mentioned in Paragraph 2.1.4, the data collected from the questionnaires were analysed and interpreted in the form of a report. Data were analysed by comparing the performance and importance of the relevant packaging systems according to the median values and the use of box plots. According to the findings of this data proposed solutions and conclusions were made in Chapter 6 and 8.

CHAPTER 3: PACKAGING

The theory regarding the relevant packaging of this study is discussed in this Chapter. This would give a better understanding and insight regarding the role of packaging, the packaging system and the impact of packaging in general and more specifically to this study.

3.1 THE ROLE OF PACKAGING

An essential element in the logistics system is packaging (Hellström 2007). Packaging is acknowledged to have a large impact on logistics performance and costs (Bowersox, Closs & Cooper, 2002). Packaging affects the efficiency of all the logistics activities (Hellström, 2007). However packaging is often regarded as a necessary cost adding element that contributes little strategic value (Lockamy III, 1995). Therefore, potential cost saving opportunities in terms of packaging are often overlooked in the logistics system.

The most significant purpose of packaging in food products is the function of preservation (Sonneveld, 2000). In essence, packaging is the process of selecting a combination of certain materials in order to create a container (Sonneveld, 2000).

According to Kooijman (1996) a range of parameters has a significant influence on the selection of materials or the packaging development process. These parameters can be grouped into three categories as showed in Figure 3.1:

- a) Micro or product environment
- b) Ambient or distribution environment
- c) Macro or market environment

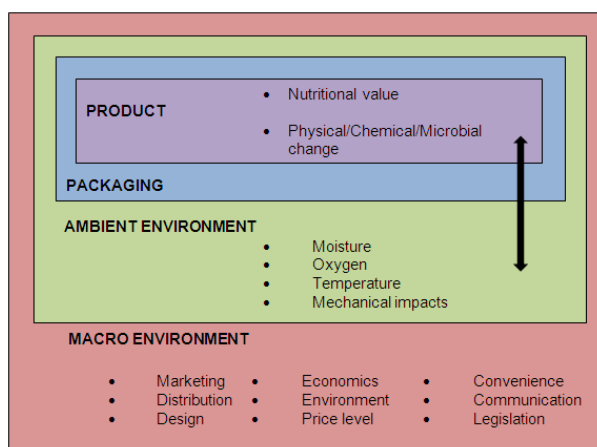


Figure 3.1: Interaction of a packaged food product with the environment (Kooijman, 1996).

As indicated in Figure 3.1 packaging interacts with the product and has an influence of the nutritional value and the physical, chemical and microbial properties of the product (Kooijman, 1996). Packaging has a direct interaction with the ambient environment as indicated in Figure 3.1. Packaging should protect the product against moisture, oxygen, temperature and mechanical impacts (Kooijman, 1996). Packaging also interacts with the macro environment (Kooijman, 1996). Packaging is used as a tool for marketing and communication. It should also display legislative, distribution and price level information. The design of packaging also depends on the type and characteristics of the product. The value of the product should also determine the cost of the packaging.

Variability exists in food packaging as supply and demand are constantly changing (Sonneveld, 2000). This is an indication that the abovementioned environments are subject to change. These changes force the packaging to adapt accordingly. For example interest rate of the economy increase, the cost of food products will also increase. This will result in higher food prices that the consumer will not be able to afford. In order to stay competitive, companies should re-evaluate the materials used in the packaging development process in order to make it more economical.

Packaging plays an important role in satisfying the needs of a wide range of participants in the supply chain (Sonneveld, 2000) and should therefore adapt within the changing environment. This occurrence encourages change in the form of packaging innovation. Consequently, packaging plays an important role in the integrated supply chain system that involves all the actors in the supply chain (Jahre & Hatteland, 2004).

3.2 PACKAGING AS AN INTEGRATED SYSTEM

The basic function of packaging is to promote product integrity by protecting the actual product against potential damage (Stewart, 1995). Packaging has three major levels/categories (Saphire, 1994) as shown in Figure 3.2:

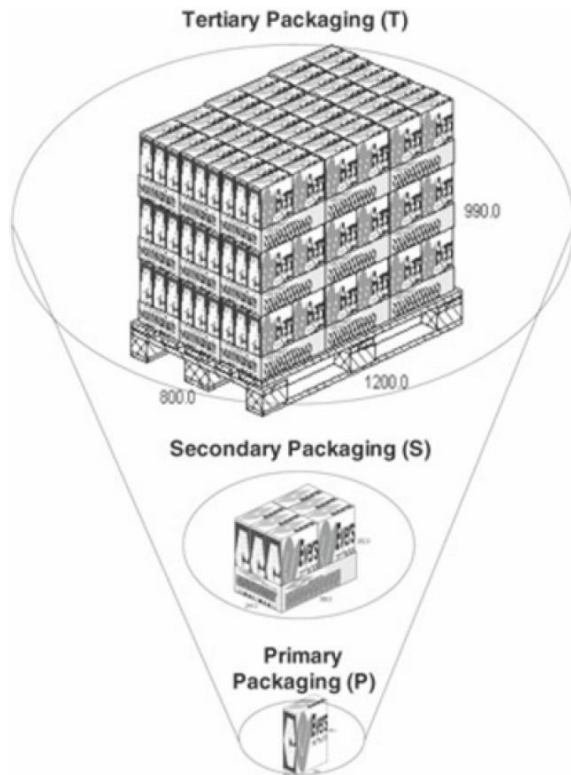


Figure 3.2: The levels or categories of the packaging system (Saghir, 2004a).

- a) Primary or retail packaging, which is used to contain the product. This is usually the punnet or plastic bag which table grapes are packed in.
- b) Secondary packaging, which is used for multi-unit packaging. This is usually the box in which the punnet or plastic bags are packed in.
- c) Tertiary or logistical packaging, which is used to transport products from the point of origin to the final destination. This is when the boxes are stacked on a pallet and wrapped, ready for shipment.

The combination of the abovementioned packaging categories is known as the packaging system or also as multi-packaging (Ngcobo, Opara & Thiart, 2012). Multi-packaging is primarily indented to protect table grapes against bruising and other post-harvest handling-related damage (Ngcobo *et al.*, 2012). This principle emphasises the interaction between the different levels of packaging and provides an understanding of their interdependence (Saghir, 2004a).

The multi-packaging system should allow adequate airflow to ensure that the heat transfers from the grapes in order to maintain an efficient cold chain (Ngcobo *et al.*, 2012). Therefore, temperature is one of the most important factors that have an influence on the postharvest life of fruit and vegetables. The physiological and biological changes in fruit and vegetables after harvest are mainly due to the change in temperature (Ravindra & Goswami, 2008).

Packaging is also becoming increasingly important, not only in terms of effective distribution and handling, but also in terms of its marketing and value-adding component (Doyle, 1996). Packaging has a direct effect on the cost of every logistical activity (Bowersox & Closs, 1996) and consequently has the potential to increase profits through cost savings and sales promotion (Stewart, 1995).

Packaging is the most important interface between the logistical system and the product (Nilsson, Fagerlund & Körner 2013). As showed in Figure 3.3, the packaging system should fulfil multiple requirements in the different business areas i.e. logistics, marketing and environmental (Johansson, Karlsson, Olsmats, & Tilander, 1997). In order to fulfil these requirements the different parameters according to Kooijman (1996) should be taken into consideration during the packaging development stage.

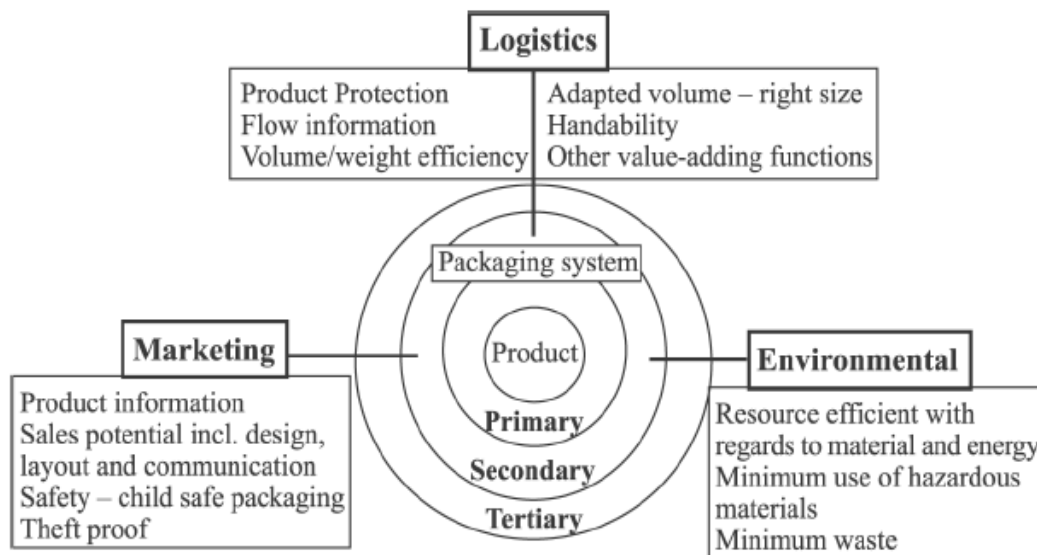


Figure 3.3: Packaging as an integrated system (Johansson *et al.*, 1997).

PACKAGING AS PART OF THE LOGISTICS SYSTEM

Packaging should be adapted (Bowersox & Closs, 1996) in order to create an effective packaging system that can fulfil the logistical areas. Packaging should therefore protect the product and improve the ease of its movement during transportation. This is very important for the movement of table grapes as it is very vulnerable to physical damage. The primary-, secondary- and tertiary packaging would have a direct impact on the logistics of the product in terms of volume and weight efficiency, handability, correct amount and size, flow information and product protection of large shipments.

PACKAGING AS PART OF THE MARKETING SYSTEM

Packaging also plays an important role in terms of marketing by communicating the brand message to the target consumer (Wells, Farley & Armstrong, 2007). Consequently, packaging can have a potentially positive effect on sales at retail level. Packaging in the table grape industry should display information regarding the product and it should promote sales potential through the graphics and design of the packaging. Secondary packaging can also be used to display the products in primary packaging sold at retail level. Primary- and secondary packaging would therefore have a direct impact on the marketing of the product in terms of safety, sales potential, theft proof and product information.

PACKAGING AS PART OF THE ENVIRONMENTAL SYSTEM

The environmental issue in terms of packaging is also a growing concern (Saghir, 2004b) and should also be taken into consideration during the packaging design process. Information regarding the recycling process of the packaging of table grapes should be clearly indicated. In the past the focus of the environmental impact of packaging was mainly on primary and/or secondary packaging recycled by the retail outlet and the consumer (Verghese & Lewis, 2007). However, focus on the environmental impact of tertiary packaging is increasing (Verghese & Lewis, 2007).

3.3 SUMMARY

The three business areas explored in this Chapter will be used as the foundation for the development of the packaging evaluation method used in this study. Therefore, the packaging evaluation would measure the entire packaging systems in terms of the three business areas.

CHAPTER 4: PACKAGING EVALUATION

The current packaging evaluation methods used in the industry are explored in this Chapter. This would give a better understanding of the different methods and the type of criteria used to collect certain information on all levels of the packaging system.

The performance of the packaging system is directly related to the performance of each packaging level (primary-, secondary and tertiary packaging) and the interactions between these packaging levels (Saghir, 2004a). Packaging also has an important influence on the efficiency and effectiveness of a supply chain (Saghir, 2004a). Improvements and innovation within the supply chain with regard to packaging logistics can only be accomplished with the adaption of evaluation models (Saghir, 2004a). These models should facilitate the evaluation of the packaging system within the supply chain, and according to Saghir (2004b) also include the activities involved during the packaging logistics process.

Therefore, the entire packaging system with regard to all the relevant role players within the supply chain should be taken into consideration during packaging evaluation.

4.1 PACKAGING SCORECARD

The Packaging Scorecard is a systematic evaluation model designed to determine the contribution of efficiency that packaging adds to the supply chain (Olsmats & Dominic, 2003). Therefore, the Packaging Scorecard promotes the improvement and innovation of the current packaging system in terms of supply chain performance. According to Olsmats and Dominic (2003) the Packaging Scorecard is used to evaluate packaging methods on all levels, i.e. primary, secondary, and tertiary levels, in terms of strengths and weaknesses.

Pos.	Criterion
1	Machinability
2	Product protection
3	Flow information
4	Volume and weight efficiency
5	Right amount and size
6	Handleability
7	Innovation
8	Product information
9	Selling capability
10	Safety
11	Reduced use of resources
12	Minimal amount of waste
13	Minimal use of hazardous substances
14	Packaging design
15	Packaging cost

Figure 4.1: Criteria for the Packaging Scorecard (Olsmats, Dominic 2003).

The different packaging methods are evaluated by each role player in the supply chain according to specific criteria (machinability, product protection, flow information, volume and weight efficiency, right amount and size, handle ability, innovation, product information, selling capability, safety, reduced use of resources, minimal amount of waste, minimal use of hazardous substances, packaging design and packaging cost) as showed in Figure 4.1 (Olsmats & Dominic, 2003). Each role player of the supply chain evaluates each criterion on a scale of 0 – 100 as indicated in Figure 4.2 (Olsmats & Dominic, 2003). Each criterion is normalised in order to present a percentage value of its supply chain significance as indicated in Figure 4.2 (Olsmats & Dominic, 2003). Actors in the supply chain then evaluate each criterion according to packaging performance on a scale of 0 – 4 (Olsmats & Dominic, 2003).

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

The gained scores are then multiplied by the normalised criterion and summarised to a average weighted average as indicated in Figure 4.2 (Olsmats & Dominic, 2003). This score gives an indication of the packaging performance in each link of the supply chain (Olsmats & Dominic, 2003).

Criteria	Weight	Normalized weight (%)	Score
Flow information	30	8.3	2
Other value-adding properties	30	8.3	0
Volume and weight efficiency	40	11.1	3
Right amount and size	50	13.9	3
Machinability	70	19.4	3
Product protection	70	19.4	4
Packaging costs	70	19.4	3
Weighted average packaging score			2.86

Figure 4.2: Packaging Scorecard calculation example (Olsmats & Dominic, 2003).

4.2 THE PACKAGING PORTFOLIO EVALUATION MODEL

The disadvantage of the Packaging Scorecard is the subjective nature of evaluation done by different actors in the supply chain. Packaging systems should be evaluated with an emphasis on logistics as the complexity of packaging decisions lies in the interaction of packaging and logistics in the supply chain (Hellström & Saghir, 2007). Different packaging

requirement perspectives exists (Lockamy III, 1995), subsequently the Packaging Portfolio Evaluation Model (Figure 4.3) was developed to accommodate the different business areas i.e. logistics, marketing and environmental (Nilsson, Fagerlund, & Körner, 2013). The requirements of the Packaging Portfolio evaluation Model are to some extent similar to the requirements used in the Packaging Portfolio Evaluation Model. The Packaging Portfolio Evaluation Model is used to evaluate the packaging portfolio and indicates the area of potential improvement of the packaging portfolio in a specific market or in different markets (Nilsson *et al.*, 2013).

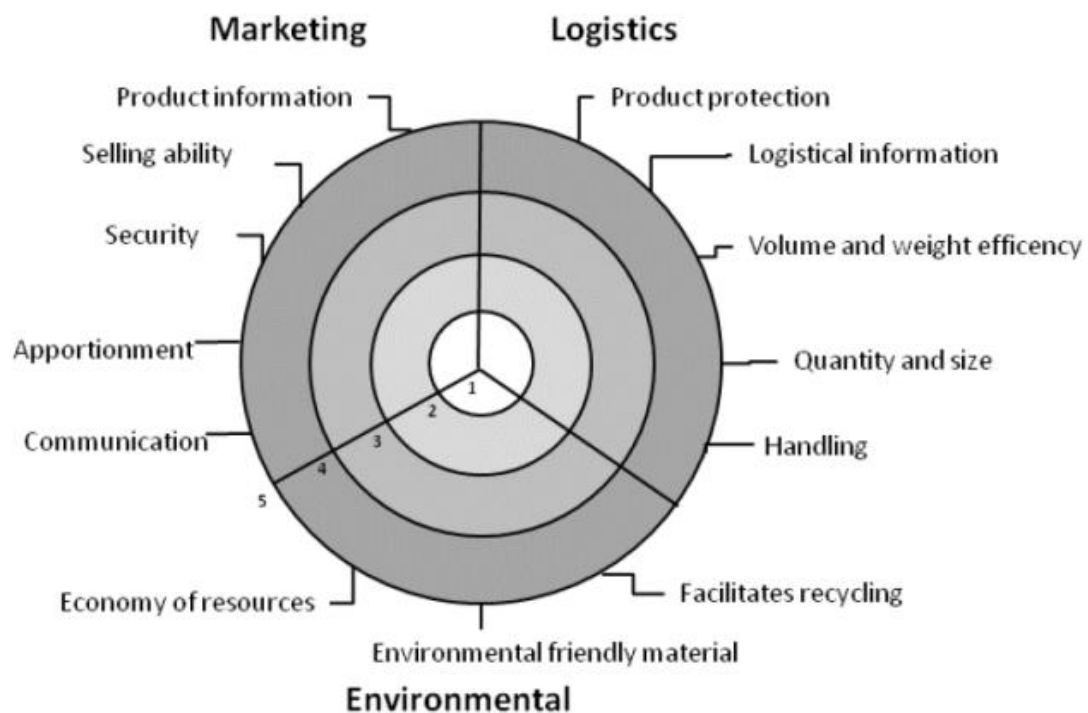


Figure 4.3: Packaging Portfolio Evaluation Model (Nilsson *et al.*, 2013).

The business areas (logistics, marketing and environmental) are divided into sub-requirements (product information, selling ability, security, apportionment, communication for marketing, economy of resources, environmentally friendly material, facilitates recycling for environmental, and handling, quantity and size, volume and weight efficiency, logistical information and product protection for logistics) (Nilsson *et al.*, 2013).

After discussions with the relevant actors in a specific market, the evaluation of the packaging portfolio is performed (Nilsson *et al.*, 2013). Each sub-requirement is rated on a scale of 1 – 5, where 1 is when the packaging portfolio does not comply with the specific requirement (Nilsson *et al.*, 2013). After each sub-requirement is rated, a line is drawn to connect the scoring points of each sub-requirement in order to create a pattern. This is

referred to as a spider graph (as indicated in Figure 4.4) which indicates the area of potential improvement (Nilsson *et al.*, 2013). Figure 4.4 is an example of what this spider graph could look like. The proposed areas for improvement in this example is quantity and size and the handling of the relevant packaging

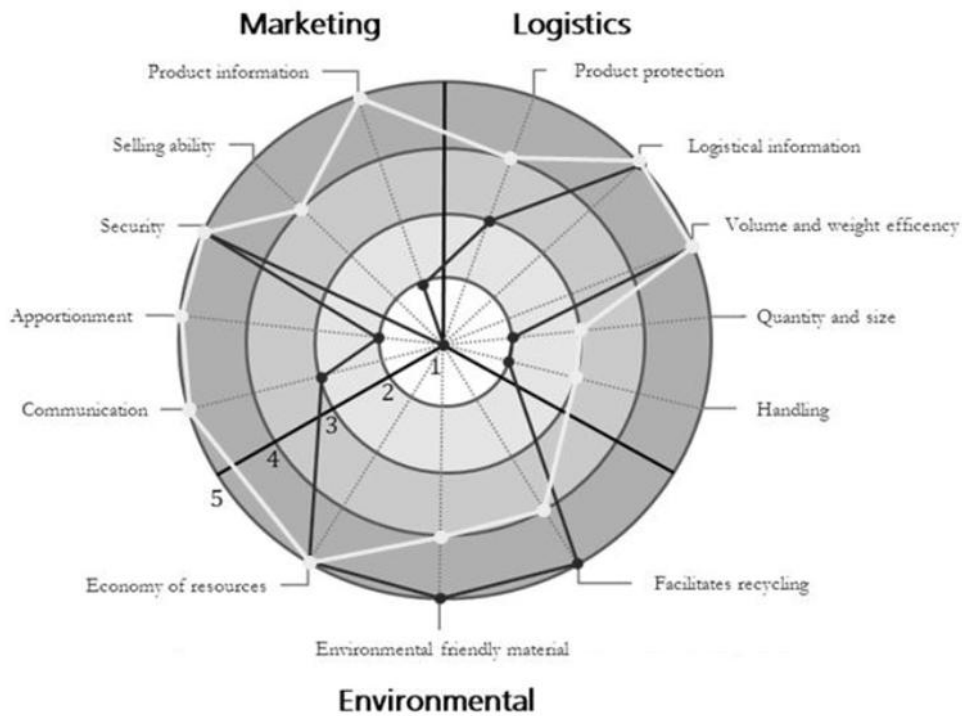


Figure 4.4: Packaging Portfolio Evaluation Model drawing example (Nilsson *et al.*, 2013).

4.3 SUMMARY

The two methods of packaging evaluation discussed in this Chapter will be used as foundation to create a new packaging questionnaire. This will be used to evaluate the importance and performance of the two types of packaging mentioned in Paragraph 2.1.4.1.

CHAPTER 5: THE NEW PACKAGING QUESTIONNAIRE

A new packaging questionnaire was developed in this Chapter. The Packaging Scorecard and the Packaging Portfolio Evaluation Model will be used as the foundation for the criteria development and layout of the new packaging questionnaire (refer to Addendum A). The new packaging questionnaire should assist in answering the research questions by indentifying the packaging related problems and possible solutions of the two packaging systems mentioned in Paragraph 2.1.3.1.

5.1 THE PACKAGING EVALUATION MODEL

According to Johansson *et al.* (1997) the packaging system should fulfil various requirements within different business areas i.e. logistics, marketing and environmental. These business areas were therefore used as base for the development of the new questionnaire (refer to Addendum A).

A combination of the Packaging Scorecard (Figure 4.1) and the Packaging Portfolio Evaluation Model (Figure 4.3) criteria were used, however more criteria were added after further observation and discussions were held with the relevant role players at Dole South Africa (Connell, 2012) and Saba Fruit in Sweden (Bjelm, 2013) as mentioned in Paragraph 2.1.3. Therefore, the criteria used in the new questionnaire are a combination of the Packaging Scorecard, the Packaging Portfolio Evaluation Model and relevant criteria from the industry. This ensured a more holistic understanding of importance of each business area in terms of the packaging system. The use of the existing criteria of the Packaging Scorecard and the Packaging Portfolio Evaluation Model also contributes towards the validity of the new questionnaire. Similar to the Packaging Scorecard, all the questions of the new questionnaire will be answered according to 1) performance and 2) importance. The new questionnaire will also have a similar structure to Packaging Portfolio Evaluation Model. The information regarding the performance and importance of the Packaging Scorecard combined with the structure of the Packaging Portfolio Evaluation Model will also answer the research questions by identifying the packaging related problems and possible solutions to the table grape problems.

Similar to the Packaging Portfolio Evaluation Model, the criteria or questions of the new questionnaire are rated on a scale from 1 – 5, where 1 indicates a low performance or importance and 5 indicates a high performance or importance. Therefore, the questions of the new questionnaire will be rated on a scale from 1 - 5. The use of the same approach as

the Packaging Portfolio Evaluation Model to scale responses promotes the validity of the new questionnaire as this method has already been successfully tested in previous research (Nilsson *et al.*, 2013). The relevant members of the supply chain have the option to only give feedback on criteria that is applicable to their knowledge specific to a certain field of work. In other words the supply chain members are therefore not forced to give feedback on criteria that they do not have an answer for. This promotes the reliability of the results obtained with the new questionnaire as feedback is only given based on the direct knowledge of the relevant supply chain members.

According to Saghir (2004b) the performance of the packaging system is directly related to the performance of the individual level of packaging i.e. primary, secondary and tertiary packaging. Therefore, the entire packaging system was taken into consideration during the evaluation process. The questionnaire for each level of packaging is different as there are different requirements for each level. Therefore, a separate questionnaire with the applicable criteria for each level of packaging was used during the evaluation process.

The questionnaire for primary and secondary packaging has the same criteria, as the roles of these types of packaging are often the same in terms of the business areas, i.e. marketing, environmental and logistics. However, the questionnaire for tertiary packaging only has criteria with regard to logistics and environmental, as marketing is not as important in terms of tertiary packaging. Figure 5.1 indicates the structure of this packaging questionnaire used to evaluate the different packaging systems. This structure is based on the structure of the Packaging Portfolio Evaluation Model i.e. marketing, environmental and marketing as part of the packaging system.

Therefore there are three business areas: marketing, environmental and logistics as indicated in Figure 5.1. These business areas are divided into sub- requirements. The sub-requirements for marketing are product information, selling ability, security and apportionment. The sub-requirements for environment are economy of resources, environmentally friendly material and facilitate recycling. The sub-requirements for logistics are quantity and size, packaging design, logistical information and product protection. For each of these sub-requirements, packaging criteria are identified according to the Packaging Scorecard (Figure 4.1) and the Packaging Portfolio Evaluation Model (Figure 4.3).

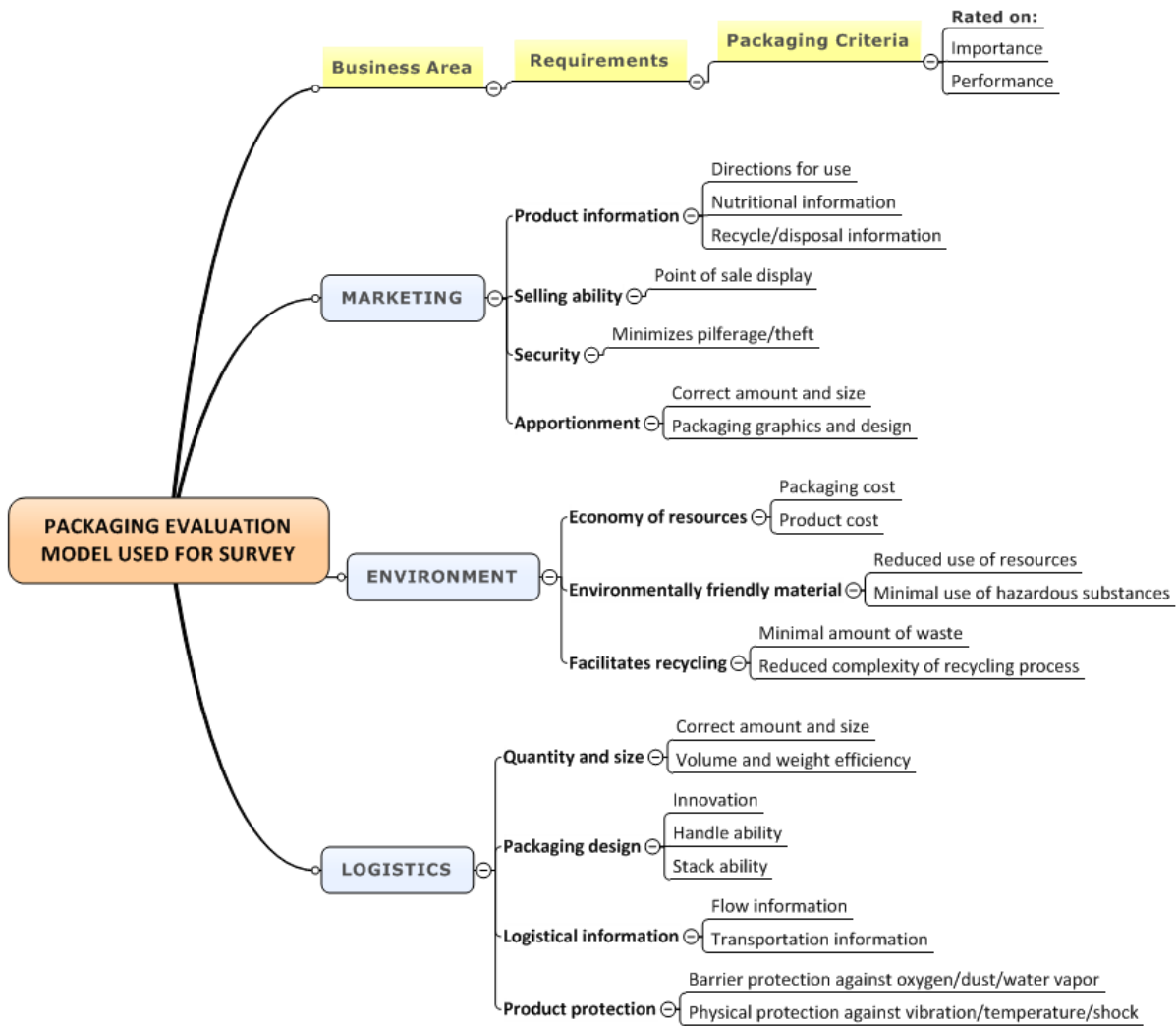


Figure 5.1: Model structure of this packaging questionnaire or model used to evaluate the different packaging systems.

5.2 THE PACKAGING SYSTEMS EVALUATED DURING THE PACKAGING EVALUATION PROCESS

As discussed in Paragraph 2.1.3.1, there are two types of packaging that showed a large amount of quality-related problems during transportation. These findings were based on the evaluation of the data received from Dole South Africa (Connell, 2012).

The two packaging systems are as follows:

- 1) A04I: The 4.5kg box with the grapes in plastic bags.

Primary packaging: Plastic bags



Secondary packaging: 4.5kg box



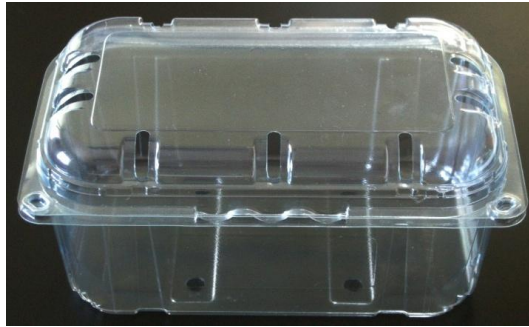
Tertiary packaging: Boxes stacked on pallet and wrapped



Figure 5.2: The packaging system of the plastic bag (Connell, 2012).

2) A05E: 5kg box with 500g punnets (10 x 500g punnets).

Primary packaging: 500g punnets



Secondary packaging: 5kg box



Tertiary packaging: Boxes stacked on pallet and wrapped



Figure 5.3: The packaging system of the 500g punnet (Connell, 2012).

Figures 5.2 and 5.3 of the A04I and the A05E packaging systems as showed above give a visual representation of the different levels of the packaging systems. The three levels of the A04I packaging system include the plastic bag (primary packaging), the 4.5kg box (secondary packaging) and the boxes stacked on a pallet and wrapped (tertiary packaging). The three levels of the A05E packaging system include the 500 gram punnet (primary packaging), the 5kg box (secondary packaging) and the pallets stacked on a pallet and wrapped (tertiary packaging). The above mentioned packaging systems showed high volumes of quality related problems as discussed in Paragraph 2.1.3.1. The quality related problems (Q, Q2) range from physical and chemical damage to the fruit, physical damage to the packaging and incorrect packaging as discussed in Paragraph 2.1.3.1.

5.3 THE SUPPLY CHAIN USED DURING THE PACKAGING EVALUATION PROCESS

The supply chain that was used during the packaging evaluation process is the export of South African table grapes to Sweden as shown in Figure 5.4. The supply chain members who only handled the containers were not included in the packaging evaluation process.

During the packaging process of the table grapes in South Africa the farmer interacts with the primary-, secondary- and tertiary packaging. The pallets or tertiary packaging are subsequently moved and stored in a warehouse. Afterwards the pallets or tertiary packaging are loaded into a container and transported to the harbour. The container is stored and later shipped from the harbour in South Africa to the harbour in Europe where it is stored.

The container is transported from the harbour in Europe to a warehouse where the pallets or tertiary packaging are unpacked. These pallets or tertiary packaging are later transported to Saba Fruit where the pallets or tertiary packaging are re-packed. The new re-packed pallets or tertiary packaging are then transported to another warehouse. These pallets or tertiary packaging are re-packed according to the orders received from the retail outlet in smaller quantities or secondary packaging.

The new re-packed pallets or tertiary packaging are subsequently transported to the retail outlet. The retail outlet will unpack the order from the tertiary- and secondary packaging and place the product in primary packaging on the shelves to be sold. The tertiary- and secondary packaging is recycled by the retail outlet. The consumer purchases the product in the primary packaging and takes it with him or her for consumption or use. The primary packaging material is recycled by the consumer.

Table 5.1: Interaction between the components of the packaging system and the logistics system.

Supply chain members	Farmer			Harbour R.S.A.	Harbour E.U.	Warehouse	Saba Fruit	Warehouse	Retail outlet	Consumer							
Logistics processes	Packaging process	Warehousing process	Load into containers	Transport	Storage and shipment	Storage and shipment	Transport	Unpacking process	Transport	Re-pack	Transport	Re-pack	Transport	Unpacking	Recycling process	Transport and use	Recycling process
	Packaging system	Packaging process	Warehousing process	Load into containers	Transport	Storage and shipment	Storage and shipment	Transport	Unpacking process	Transport	Re-pack	Transport	Re-pack	Transport	Unpacking	Recycling process	Transport and use
Primary	X													X		X	X
Secondary	X									X		X		X	X		
Tertiary	X	X	X				X	X	X	X	X	X	X	X	X		
Container				X	X	X	X	X									

5.4 SUMMARY

As discussed in Chapter 5 the new packaging questionnaire (refer to Addendum A) will evaluate the packaging systems of A04I and the A05E as discussed in Paragraph 5.1. Each level of the packaging system will be evaluated by the specific role players in the supply chain who interacted with it as indicated in Figure 5.1. The new packaging questionnaire will be used to collect and analyse data.

CHAPTER 6: DATA COLLECTION AND ANALYSIS

The data collected during the packaging evaluation process will be analysed in this Chapter. This will assist in finding the source of the specific packaging related problems in order to find a way to address these problems.

6.1 NEW PACKAGING QUESTIONNAIRE STATISTICS

As discussed in Paragraph 5.2 the supply chain for table grape exports from South Africa to Sweden was used during packaging evaluation process. Dole South Africa supplied the contact details of the members of the supply chain in South Africa used in the evaluation process of the relevant packaging systems. Saba Fruit supplied the contact details of the members of the supply chain in Sweden. Lund in Sweden was the final stage in the supply chain evaluation process as a substantial amount of research was conducted there. Therefore, the sampling method used is convenience sampling. This technique involves the selection of the most accessible subjects (Marshall, 1996).

The role players within the supply chain who only handled the containers were not included in the evaluation process. The primary data were collected from the relevant role players within the supply chain with the new questionnaire developed in Chapter 5. As mentioned in Chapter 5 the new packaging questionnaire will basically measure two variables, the performance and importance of each criterion as perceived by these members (as indicated in Figure 5.1).

The score of importance is subtracted from the score of performance. The result is called the perceived difference. If the score of performance is greater than the score of importance the perceived difference will be positive. In other words, the members of the supply chain perceived the specific aspect of the packaging system to perform better or equal to the importance thereof.

When the score of performance is less than the score of importance the perceived difference will be negative. In other words, the members of the supply chain perceived the specific aspect of the packaging system to be at a certain level of importance and did not perform accordingly or an underperformance. Therefore, the first quartile (Q_1) of a certain packaging requirement or business area received a value less than -1 or $Q_1 < -1$ (as indicated in Table 6.1) it was regarded as an underperformance and should be improved.

When the score of performance was higher than the score of importance, the perceived difference will be a positive or an over performance. In other words, the members of the supply chain perceived the specific aspect of the packaging system to perform better than the importance thereof. Therefore the third quartile (Q_3) of a certain packaging requirement or business area received a value more than 0 (or $Q_3 > 0$) it was regarded as an over performance as indicated in Table 6.1. This was when the performance of the packaging criteria was higher than the importance thereof. It should also receive attention as too many resources could possibly be invested in the particular packaging requirement or business area.

If the interquartile range of responses was relatively large with an interquartile range ≥ 2 (as indicated in Table 6.1), the response of the supply chain members was relatively heterogeneous. In other words, the perception of the importance and performance of the specific packaging systems was very diverse.

If the interquartile range of responses was relatively small with an interquartile range < 2 (as indicated in Table 6.1), the response of the supply chain members was relatively homogeneous. In other words, the perception of the importance and performance of the specific packaging systems was very similar.

The number of responses as mentioned in Table 6.1 was insufficient and therefore no statistical tests could be performed. It was expected for responses to be low due to the limited amount of supply chain members who were able to give the relevant feedback. Descriptive statistics (box plots with quartiles) are used for interpretations.

Table 6.1: New packaging questionnaire statistics.

Measurement	Description
$Q_1 < -1$	Underperformance
$Q_3 > 0$	Over performance
Interquartile range ≥ 2	Relatively large interquartile range
Interquartile range < 2	Relatively small interquartile range
Responses (plastic bag)	n = 7
Responses (4.5kg box)	n = 5
Responses (boxes stacked on pallet and wrapped)	n = 4
Responses (500g punnet)	n = 5
Responses (5kg box)	n = 4
Responses (boxes stacked on pallet and wrapped)	n = 4

The above mentioned measurements will be used in the following section. This creates a parameter according to which data will be evaluated and classified. This would assist in identifying the source of the packaging related problems.

6.2 A04I: 4.5KG BOX WITH THE GRAPES IN PLASTIC BAGS

The overall performance of the 4.5kg box with the grapes in plastic bags will be evaluated according to the individual requirements for each business area in each level of the packaging system. The length of the lines of the different packaging criteria illustrates the median of importance as perceived by all the relevant members within the supply chain. The circles of the different packaging criteria illustrate the median of performance as perceived by these members of the supply chain. An underperformance is when the line (importance) received a higher score than the circle (performance). An over performance is when the line (importance) received a lower score than the circle (performance). A good performance is when the line (importance) received the same score as the circle (performance). In general there was an underperformance regarding the different packaging criteria, however, each level of packaging will be discussed individually.

6.2.1 PRIMARY PACKAGING: PLASTIC BAG

The overall performance of the plastic bags related to primary packaging is indicated in Table 6.2. In general there was an under performance regarding the plastic bags as the median of importance (line) received a higher score than the median of performance (circle). The requirements for each business area of this packaging will be looked at individually.

MARKETING AS PACKAGING CRITERIA

The relevant role players in the supply chain were not satisfied with the nutritional information in terms of importance. However, recycling- or disposal information and directions for use performed better. The role players within the supply chain showed an overall satisfaction with the point of sale display performance in terms of importance. The plastics bags fail to minimize pilferage or theft to adhere to its importance. The relevant role players within the supply chain were not satisfied with the amount and size according to the apportionment of the packaging. The performance of the correct amount and size did not adhere to the importance it has to the involved role players within the supply chain, although the graphics and design of the packaging showed a good performance with regard to importance.

ENVIRONMENT AS PACKAGING CRITERIA

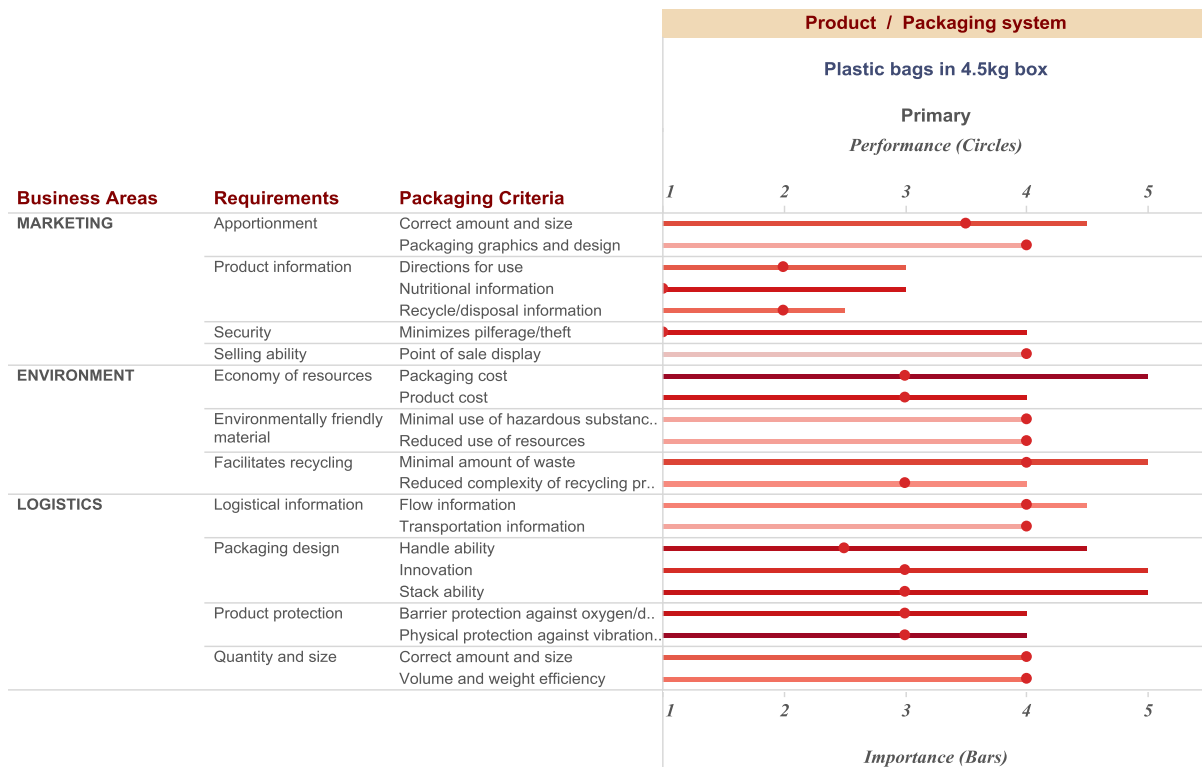
The cost of the product and the packaging are not economical according to the involved role players within the supply chain. The packaging and product cost underperformed according to importance. The relevant members of the supply chain indicated that the packaging reduces the use of resources and it minimizes the use of hazardous substances. The complexity of the recycling process and the amount of waste of the plastic bag also underperformed slightly regarding the importance thereof.

LOGISTICS AS PACKAGING CRITERIA

The relevant role players within the supply chain were satisfied with the innovation of the packaging; however, they were not satisfied with the handling and stacking abilities of the plastic bags. The flow information underperformed slightly. The physical and barrier protection of the packaging also underperformed in terms of its importance.

Table 6.2: Overall performance of plastic bags (Primary Packaging).

Bullets & Bars



6.2.1.1 **MARKETING IN TERMS OF PACKAGING REQUIREMENTS**

The box plots in Figure 6.1 are a summary of the results for the perceived difference between importance and performance of the marketing criteria for the plastic bag. There was a general underperformance regarding product information with $Q_1 = -2$ ($Q_1 < -1$) as indicated in Figure 6.1. This is when the performance of the packaging criteria was lower than the importance thereof. There was an overall satisfaction with the selling ability with $Q_1 = 0$. With the performance of the packaging criteria was equal to the importance thereof. Security showed an underperformance in terms of importance with $Q_1 = -3$ ($Q_1 < -1$). The performance of the packaging criteria was lower than the importance thereof. The relevant role players were satisfied with the performance regarding the apportionment with $Q_1 = -1$. The performance of the packaging criteria was equal to the importance thereof.

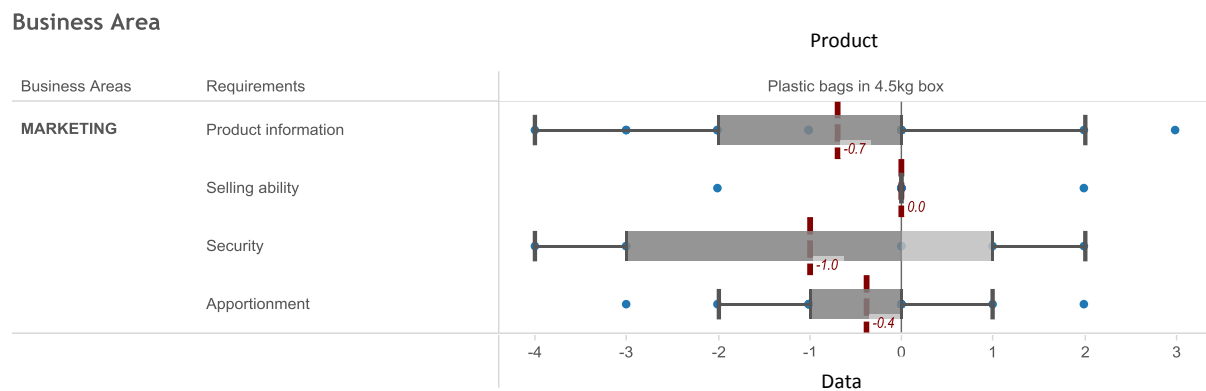


Figure 6.1: Marketing requirements for plastic bag (n = 7).

As indicated in Figure 6.2 the marketing aspect of grapes in the plastic bag underperformed with $Q_1 = -2$ ($Q_1 < -1$). The interquartile range ($Q_3 - Q_1 = 2$) is relatively large and indicates that the response of the supply chain members was relatively heterogeneous. An outlier is also present as shown in Figure 6.2. Individual requirements such as product information and security need improvement.

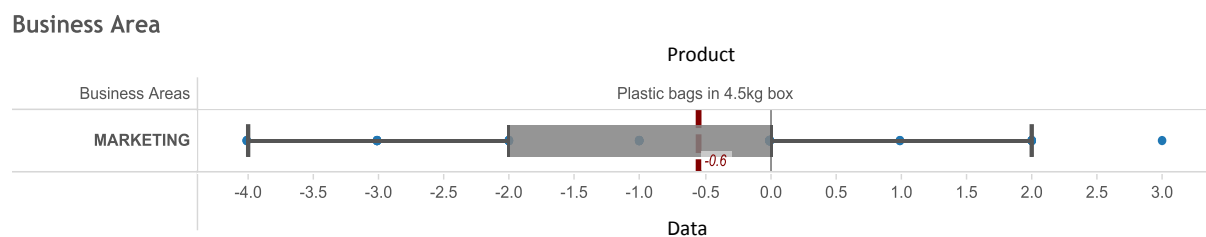


Figure 6.2: Marketing summary of plastic bag (n = 7).

6.2.1.2 ENVIRONMENT IN TERMS OF PACKAGING REQUIREMENTS

The box plots in Figure 6.3 are a summary of the data set of the environmental criteria for the plastic bag. Economy of resources underperformed with $Q_1 = -3$ ($Q_1 < -1$). The performance of the packaging criteria was lower than the importance thereof.

The relevant role players within the supply chain were generally satisfied with the performance of the environmental aspect regarding the plastic bags with $Q_1 = -1$. The performance of the packaging criteria was equal to the importance thereof. The recycling process of the packaging performed well with regard to its importance with $Q_1 = -1$.

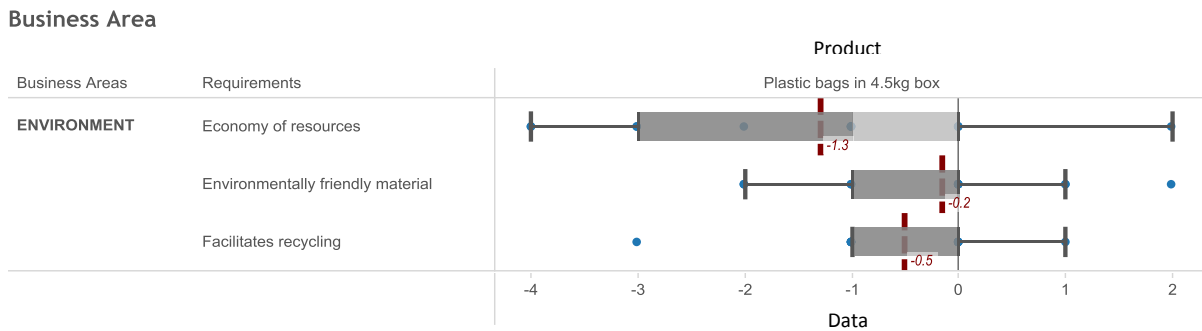


Figure 6.3: Environmental requirements for plastic bag (n = 7).

In general, the environmental criteria performed relatively well with $Q_1 = -1$ (as indicated in Figure 6.4). This is when the performance of the packaging criteria is equal to the importance thereof. The interquartile range ($Q_3 - Q_1 = 1$) is relatively small and indicates that the response of the supply chain members was relatively homogeneous. Two outliers are also present as shown in Figure 6.4. Individual requirements such as product information and security need improvement.

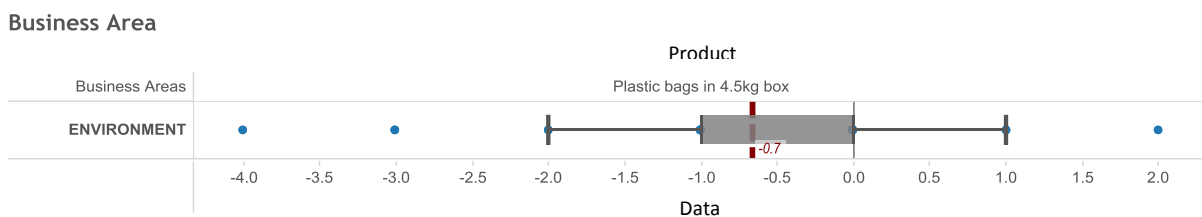


Figure 6.4: Environmental summary of plastic bag (n = 7).

6.2.1.3 LOGISTICS IN TERMS OF PACKAGING REQUIREMENTS

The box plots in Figure 6.5 are a summary of the data set of the logistics criteria for the plastic bag. Overall, the relevant role players were satisfied with the performance regarding

the quantity and size of the packaging in terms of its logistics with $Q_1 = -1$. With the performance of the packaging criteria was equal to the importance thereof. In general, the packaging design underperformed in terms of importance with $Q_1 = -2$ ($Q_1 < -1$) as indicated in Figure 6.5. This is when the performance of the packaging criteria was lower than the importance thereof. The general performance of the logistical information of the packaging was good with regard to its importance $Q_1 = -1$. With the performance of the packaging criteria was equal to the importance thereof. The relevant role players in the supply chain were not satisfied with the general performance of the product protection of the plastic bags with $Q_1 = -2$ ($Q_1 < -1$). This is when the performance of the packaging criteria was lower than the importance thereof.

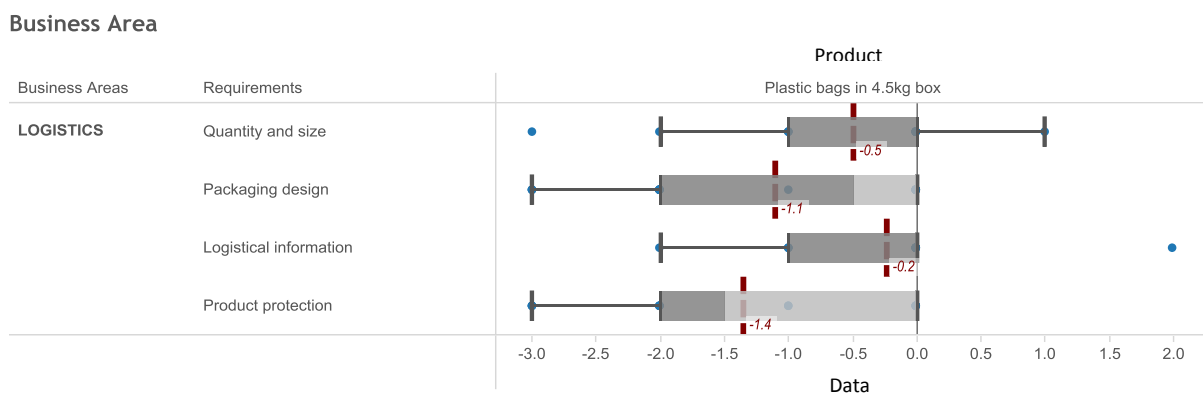


Figure 6.5: Logistics requirements for plastic bag (n = 7).

In general, the logistics of the plastic bags as indicated in Figure 6.6 did perform poorly with $Q_1 = -2$ ($Q_1 < -1$) where the performance of the packaging criteria was lower than the importance thereof. The interquartile range ($Q_3 - Q_1 = 2$) is relatively large and indicates that the response of the supply chain members was relatively heterogeneous. An outlier is also present as shown in Figure 6.6. Attention should be given to packaging design and product protection in order to improve the overall logistics of the plastic bag.

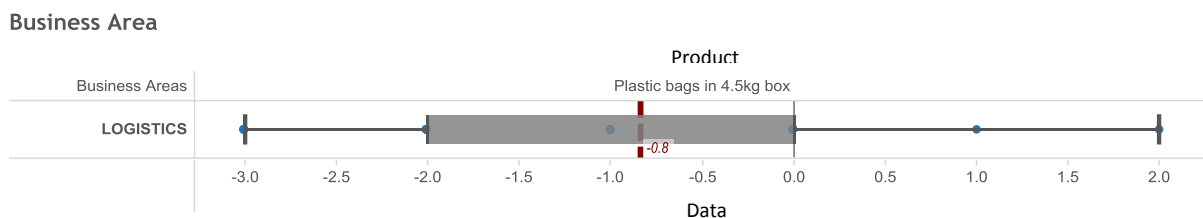


Figure 6.6: Logistical summary of plastic bag (n = 7).

6.2.2 SECONDARY PACKAGING: 4.5KG BOX

The overall performance of the 4.5kg boxes related to secondary packaging is indicated in Table 6.3. In general there was an under performance regarding the 4.5kg box as the median of importance (line) received a higher score than the median of performance (circle). The requirements for each business area of this packaging will be looked at individually.

MARKETING AS PACKAGING CRITERIA

The nutritional information of this packaging was insufficient according to the relevant role players in the supply chain. The point of sale display of the 4.5kg box performed well with regard to importance. The packaging fails to minimize pilferage or theft in terms of its importance. The relevant role players within the supply chain were also not satisfied with the packaging graphics and design with regard to its importance.

ENVIRONMENT AS PACKAGING CRITERIA

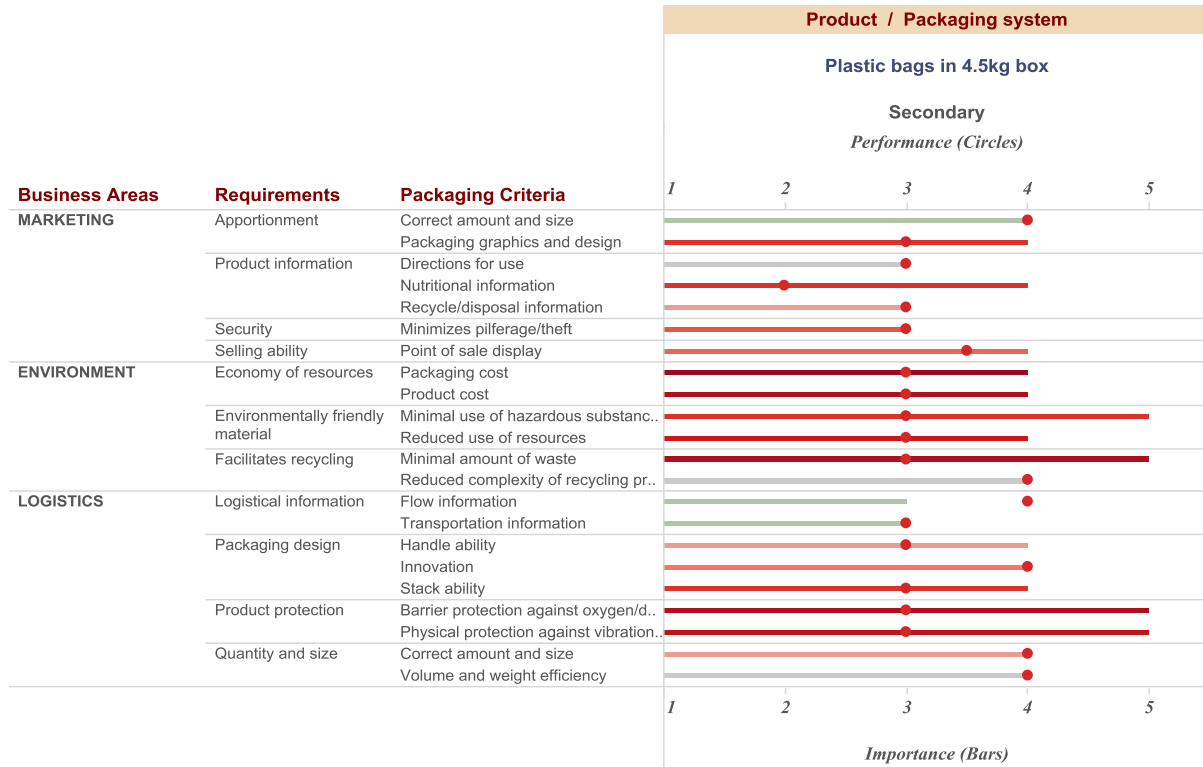
The relevant role players in the supply chain were not satisfied with the packaging- and product cost as it was not economical. The role players within the supply chain were not satisfied with the packaging with regard to reduced use of resources and the minimal use of hazardous substances. The packaging performed well with regard to a reduced complexity of the recycling process. However, the relevant role players within the supply chain were not satisfied with the amount of waste of the packaging in the recycling process.

LOGISTICS AS PACKAGING CRITERIA

The handle ability of the 4.5kg box performed well with regard to the packaging design. However, the innovation and stacking abilities of the packaging underperformed in terms of importance. The role players in the supply chain were generally satisfied with the packaging design the amount and size in terms of logistics and the volume and weight efficiency. The relevant role players in the supply chain were very much satisfied with the flow and transport information regarding the 4.5kg box. However, this could also indicate that there are too much resources invested in this particular packaging requirement. The physical and barrier protection of the packaging underperformed in terms of importance.

Table 6.3: Overall performance of 4.5kg boxes (Secondary Packaging).

Bullets & Bars



6.2.2.1 MARKETING IN TERMS OF PACKAGING REQUIREMENTS

The box plots in Figure 6.7 are a summary of the data set of the marketing criteria for the 4.5kg box. In general, the product information regarding the 4.5kg box performed well with regard to its importance with $Q_1 = 0$. With the performance of the packaging criteria was equal to the importance thereof. The selling ability of the 4.5kg box performed well with regard to importance performed well with $Q_1 = 0$. The relevant role players in the supply chain were not satisfied with the security of the 4.5kg box with $Q_1 = -2$ ($Q_1 < -1$). This is when the performance of the packaging criteria was lower than the importance thereof. The correct amount and size in terms of apportionment performed well with regard to its importance with $Q_1 = -1$. This is when the performance of the packaging criteria was equal to the importance thereof.

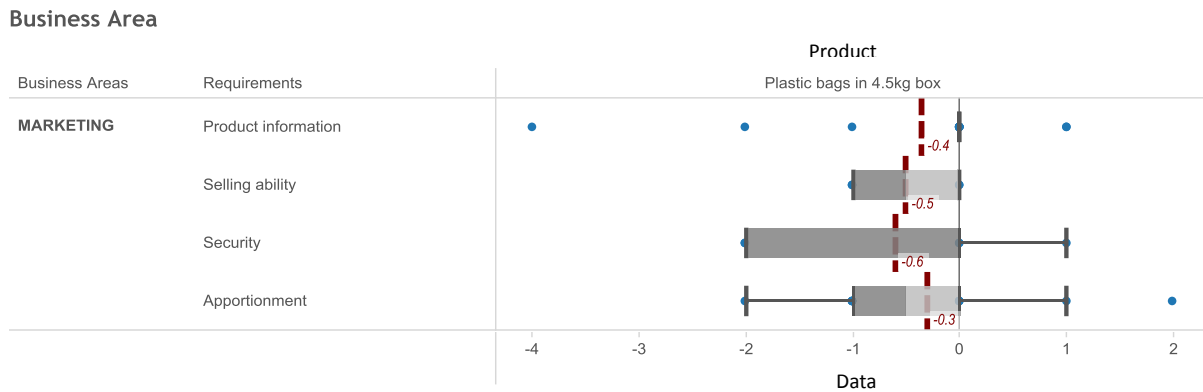


Figure 6.7: Marketing requirements for plastic bag (n = 5).

In general, the marketing aspect of the 4.5kg box performed well with $Q_1 = -1$ (as indicated in Figure 6.8). This is when the performance of the packaging criteria was equal to the importance thereof. The interquartile range ($Q_3 - Q_1 = 1$) is relatively small and indicates that the response of the supply chain members was relatively homogeneous. Two outliers are also present as shown in Figure 6.8.

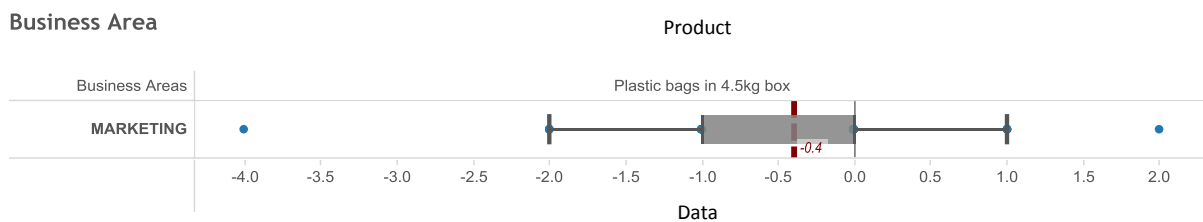


Figure 6.8: Marketing summary of 4.5kg box (n = 5).

6.2.2.2 ENVIRONMENT IN TERMS OF PACKAGING REQUIREMENTS

The box plots in Figure 6.9 are a summary of the data set of the environmental criteria for the 4.5kg box. The general the economy of resources showed an underperformance with regard to its importance with $Q_1 = -3$ ($Q_1 < -1$) as indicated in Figure 6.9. This is when the performance of the packaging criteria was lower than the importance thereof. The environmental aspect of the 4.5kg box underperformed in terms of importance $Q_1 = -2$ ($Q_1 < -1$) as indicated in Figure 6.9. The performance of the packaging criteria was lower than the importance thereof. The supply chain members indicated that the 4.5kg box facilitates recycling with $Q_1 = -1$ as indicated in Figure 6.9.

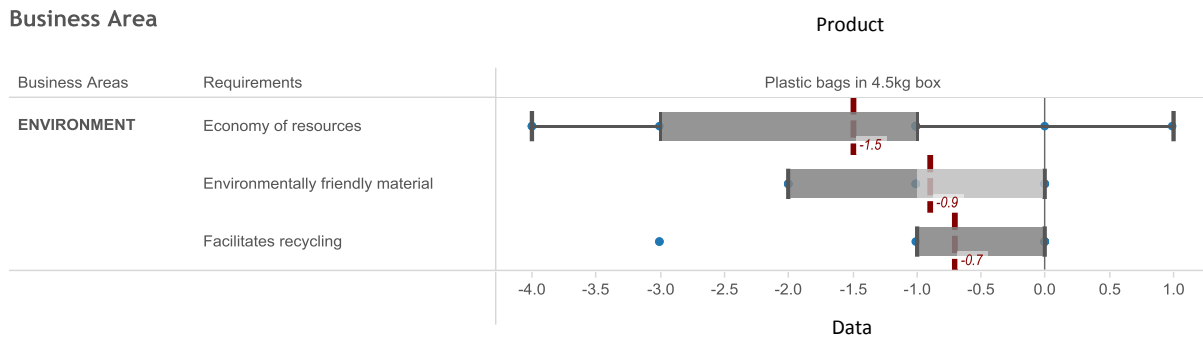


Figure 6.9: Environmental requirements for plastic bag (n = 5).

The environmental aspect of the 4.5kg box underperformed as indicated in Figure 6.10 with $Q_1 = -2$ ($Q_1 < -1$). The interquartile range ($Q_3 - Q_1 = 2$) is relatively large and indicates that the response of the supply chain members was relatively heterogeneous as shown in Figure 6.10. It is important to improve the economy of resources and make the 4.5kg box more environmentally friendly.

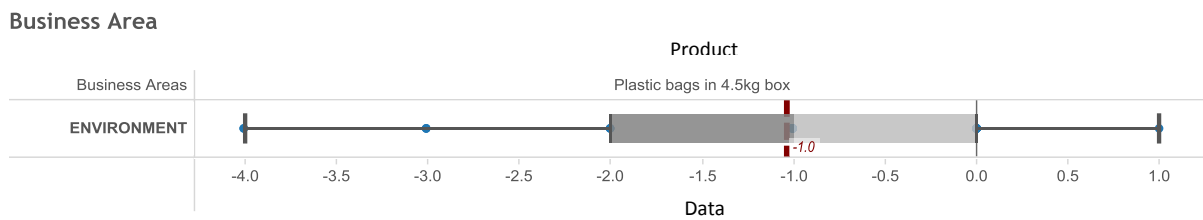


Figure 6.10: Environmental summary of 4.5kg box (n = 5).

6.2.2.3 LOGISTICS IN TERMS OF PACKAGING REQUIREMENTS

The box plots in Figure 6.11 are a summary of the data set of the logistics criteria for the 4.5kg box. In general, the quantity and size of the 4.5kg box performed well in terms of its importance with $Q_1 = -1$ as indicated in Figure 6.11. The performance of the packaging criteria was equal to the importance thereof. The packaging design of the 4.5kg box performed generally well with $Q_1 = -1$ as indicated in Figure 6.11. The logistical information in the packaging over performed with $Q_3 > 0$ as indicated in Figure 6.11. This indicates that there is too much resource invested in logistical information. The relevant role players in the supply chain were generally not satisfied with the performance of the product protection of the 4.5kg box with $Q_1 = -2$ ($Q_1 < -1$) as indicated in Figure 6.11. The performance of the packaging criteria was lower than the importance thereof.

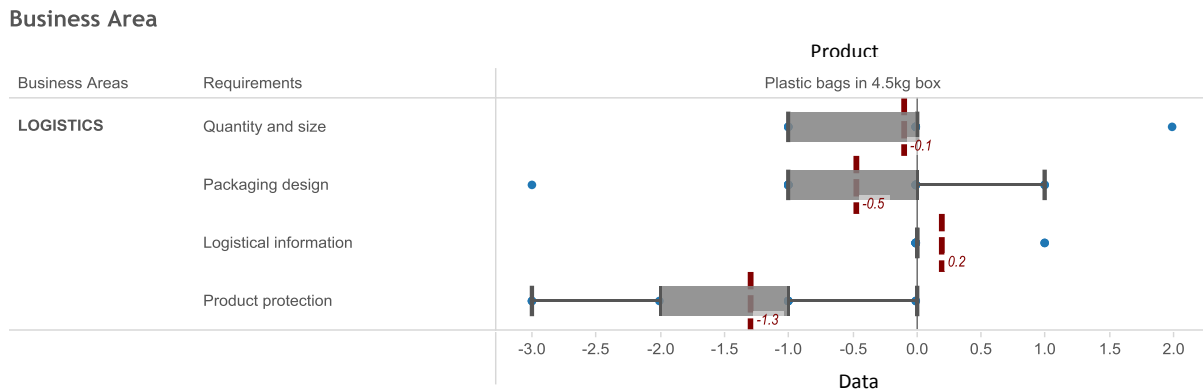


Figure 6.11: Logistics requirements for plastic bag (n = 5).

In general, the logistics aspect of the 4.5kg box performed well as indicated in Figure 6.12 with $Q_1 = -1$. The performance of the packaging criteria was equal to the importance thereof. Attention should only be given to certain criteria. The interquartile range ($Q_3 - Q_1 = 1$) is relatively small and indicates that the response of the supply chain members was relatively homogeneous. Two outliers are also present as shown in Figure 6.12.

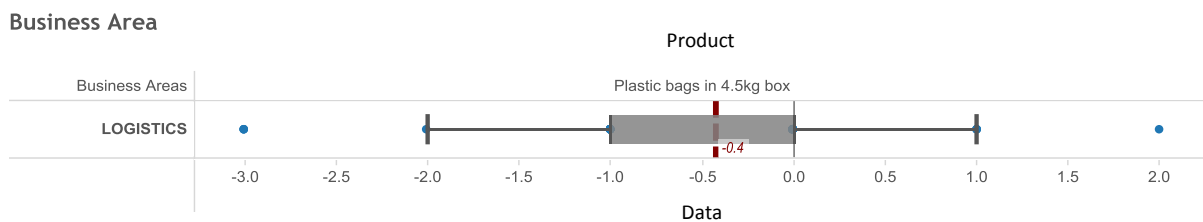


Figure 6.12: Logistical summary of 4.5kg box (n = 5).

6.2.3 TERTIARY PACKAGING: BOXES STACKED ON PALLET AND WRAPPED

The overall performance of the boxes stacked on a pallet and wrapped related to tertiary packaging is indicated in Table 6.4. In general there was an under performance regarding the boxes stacked on a pallet and wrapped as the median of the importance (line) received a higher score than the median of performance (circle). The requirements for each business area of this packaging will be looked at individually.

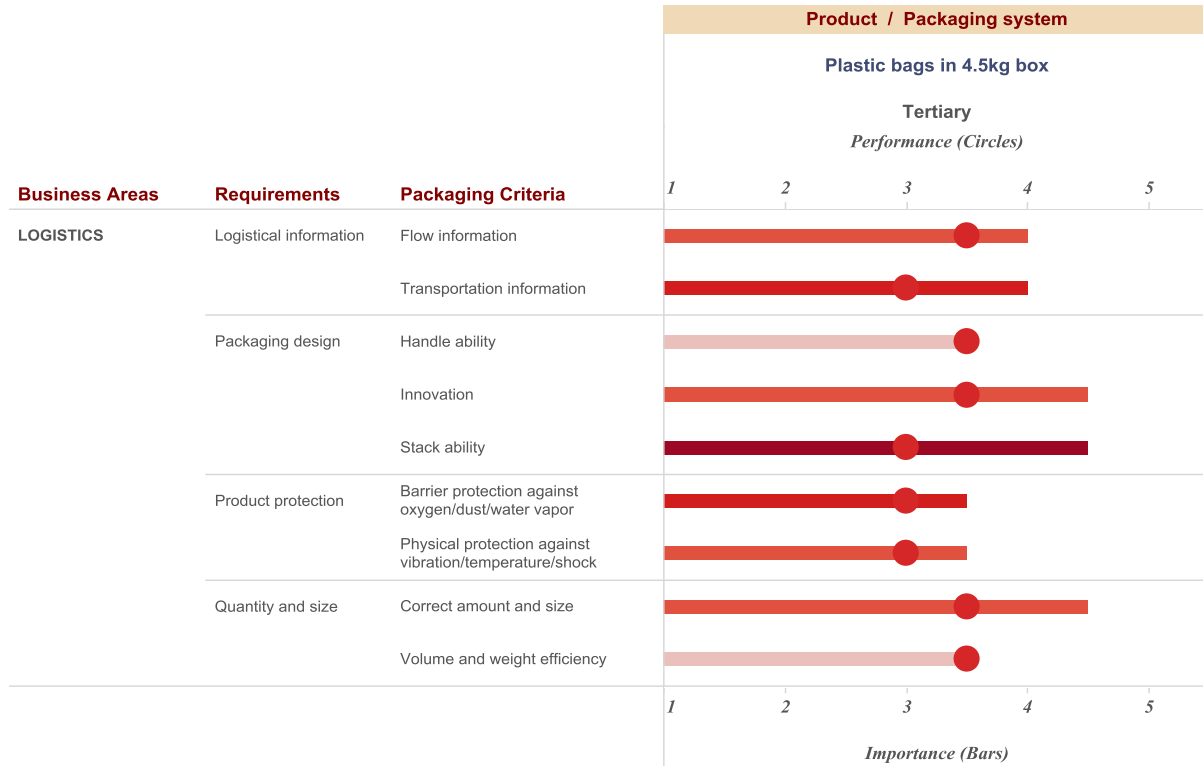
LOGISTICS AS PACKAGING CRITERIA

The role players in the supply chain were satisfied with the volume and weight, but less satisfied with the amount and size efficiency in terms of logistics. The stacking ability and innovation of the packaging did not satisfy the relevant role players in the supply chain. The flow information performed relatively well with regard to its importance. However, the

transportation information of the packaging did not satisfy the relevant role players in the supply chain. The physical and barrier protection of the boxes stacked on the pallet did not satisfy the role players in the supply chain.

Table 6.4: Overall performance of stacked on a pallet and wrapped (Tertiary Packaging).

Bullets & Bars



6.2.3.1 LOGISTICS IN TERMS OF PACKAGING REQUIREMENTS

The box plots in Figure 6.13 are a summary of the data set of the logistics criteria for the boxes stacked on a pallet and wrapped. The quantity and size of the packaging performed well with regard to the importance with $Q_1 = -1$ as indicated in Figure 6.13. The performance of the packaging criteria was equal to the importance thereof. In general, the packaging design performed well in terms of importance $Q_1 = -1$ as indicated in Figure 6.13. The logistical information performed generally well with $Q_1 = -1$ as indicated in Figure 6.13. The product protection of the packaging also did not perform well in terms of importance with $Q_1 = -1.5$ ($Q_1 < -1$). The performance of the packaging criteria was lower than the importance thereof

Business Area

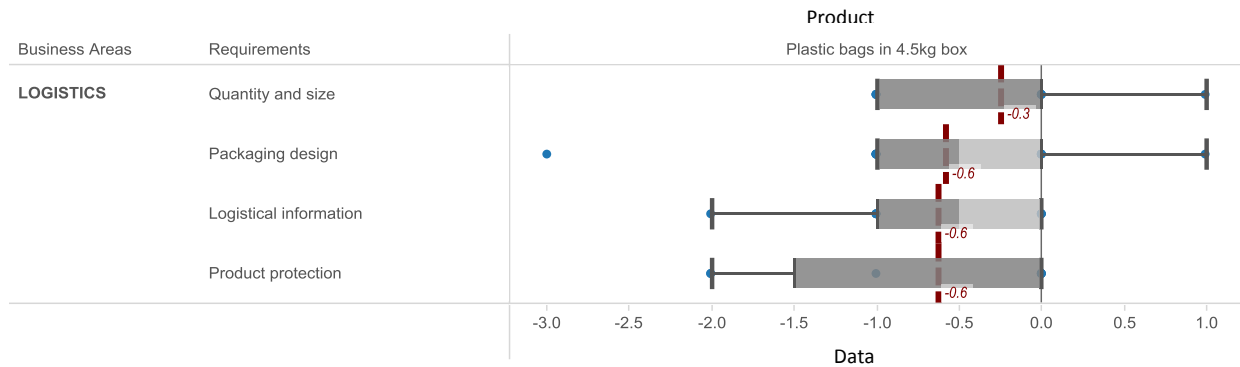


Figure 6.13: Logistical requirements for boxes stacked on pallet (n = 4).

The logistics of the boxes stacked on a pallet and wrapped performed well with $Q_1 = 1$ and $Q_3 = 0$ (as indicated in Figure 6.14). The performance of the packaging criteria was equal to the importance thereof. The interquartile range ($Q_3 - Q_1 = 1$) is relatively small and indicates that the response of the supply chain members was relatively homogeneous. An outlier is also present as shown in Figure 6.14. Attention should be given to certain individual criteria.

Business Area

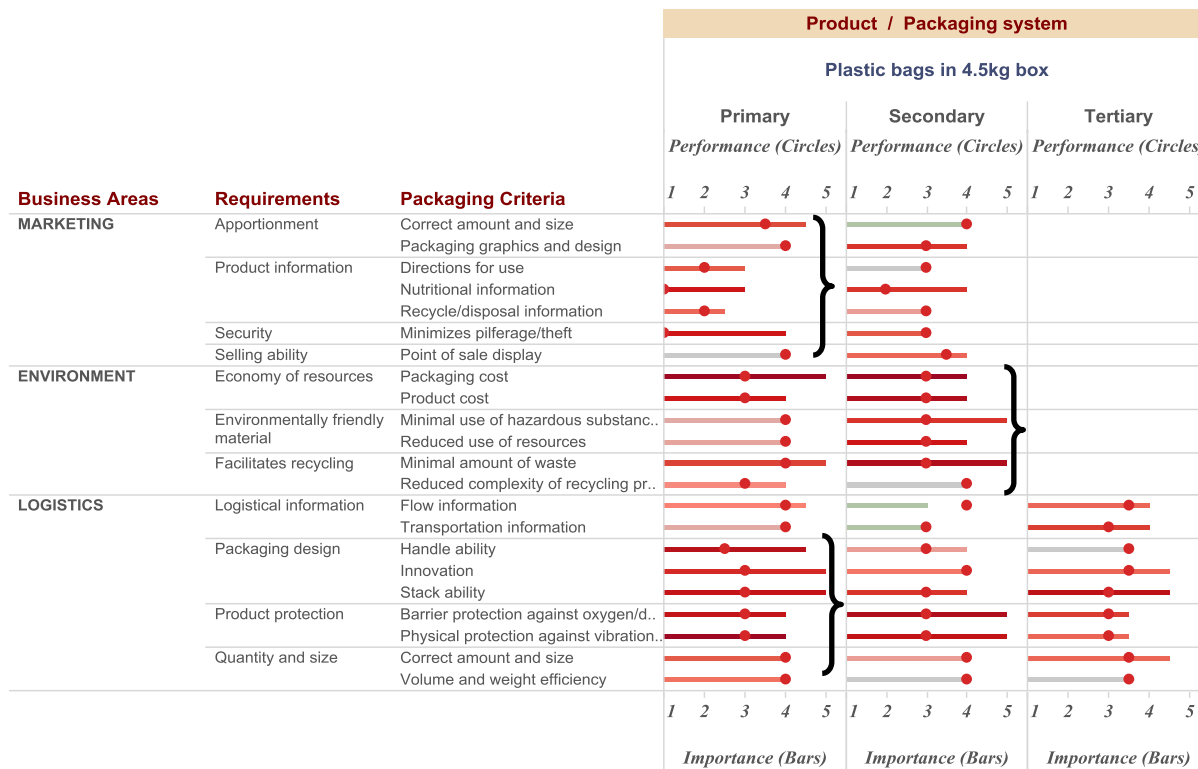


Figure 6.14: Logistical summary of boxes stacked on pallet (n = 4).

In summary, the overall performance of the 4.5kg box with the grapes in plastic bags is indicated in Table 6.5. The specific areas with a significant underperformance that should be improved are the marketing and logistics of the plastic bag and the environmental aspect of the 4.5kg box.

Table 6.5: Overall performance of 4.5kg box with the grapes in plastic bags.

Bullets & Bars



6.3 A05E: 5KG (10 X 500G PUNNETS)

The overall performance of the 5kg box with the 500g punnets will be evaluated according to the individual requirements for each business area in each level of the packaging system.

6.3.1 PRIMARY PACKAGING: 500G PUNNET

The overall performance of the punnets related to primary packaging is indicated in Table 6.6. In general there was an under performance regarding the 500 gram punnets as the median of importance (line) received a higher score than the median of performance (circle). The requirements for each business area of this packaging will be looked at individually.

MARKETING AS PACKAGING CRITERIA

The nutritional information as well as its recycling and disposal underperformed according to the relevant role players in the supply. However, the directions for use performed well in terms of its importance. The role players in the supply chain were satisfied with the point of display of the packaging. The punnets do minimize pilferage or theft to a certain extend. The

amount and size and the packaging graphics and design performed well in terms of importance.

ENVIRONMENT AS PACKAGING CRITERIA

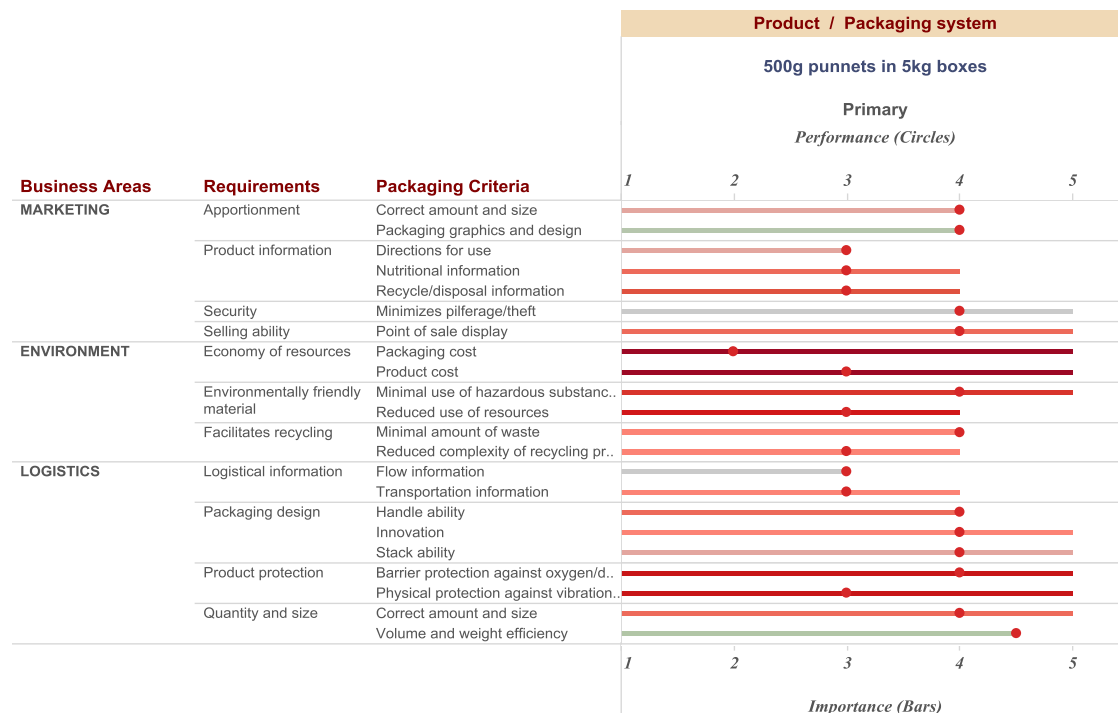
The role players in the supply chain were not satisfied with the packaging and product costs. Therefore, the packaging and product costs are not economical. According to the role players in the supply chain, the packaging also did not reduce the use of resources or minimize the use of hazardous substances adequately. In general, the punnets facilitate recycling with a minimal amount of waste and a reduced complexity with regard to the recycling process.

LOGISTICS AS PACKAGING CRITERIA

The relevant role players in the supply chain were satisfied with the volume and weight efficiency of the packaging. The role players in the supply chain were satisfied with the stack ability of the punnets. The innovation and the handling ability of the packaging did not perform well with regard to its importance. Flow information performed well with regard to importance. Transportation information underperformed slightly. The relevant members of the supply chain were not satisfied with the physical or barrier protection of the packaging.

Table 6.6: Overall performance of punnet (Primary Packaging).

Bullets & Bars



6.3.1.1 **MARKETING IN TERMS OF PACKAGING REQUIREMENTS**

The box plots in Figure 6.15 are a summary of the data set of the marketing criteria for the 500 gram punnet. The product information to perform generally well with $Q_1 = -1$ as indicated in Figure 6.15. The performance of the packaging criteria was equal to the importance thereof. The selling ability of the punnets performed relatively well with $Q_1 = -1$ as indicated in Figure 6.15. The relevant role players in the supply chain were satisfied with the security of the packaging with $Q_1 = -1$ as indicated in Figure 6.15. The apportionment of the punnets also satisfied the role players in the supply chain with $Q_1 = 0$.

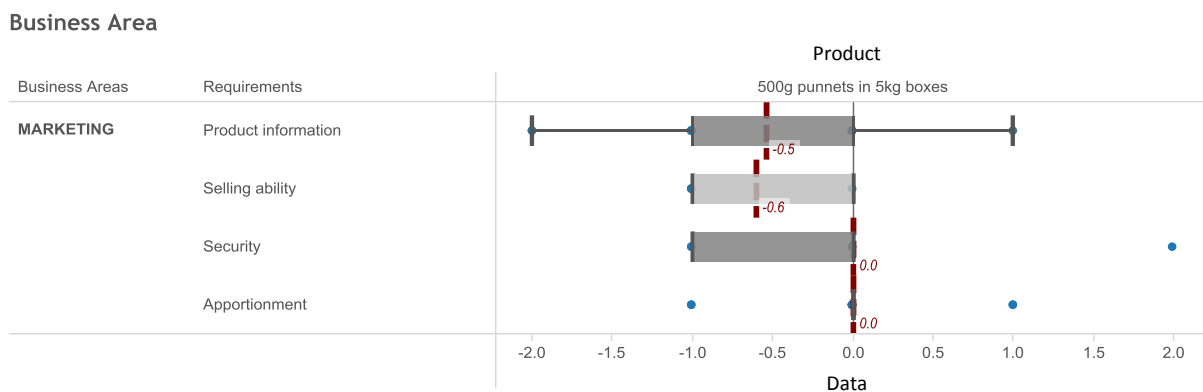


Figure 6.15: Marketing requirements for punnet (n = 5).

In general, the marketing criteria of the punnets performed well (as indicated in Figure 6.16) with $Q_1 = -1$ and $Q_3 = 0$. The performance of the packaging criteria was equal to the importance thereof. The interquartile range ($Q_3 - Q_1 = 1$) is relatively small and indicates that the response of the supply chain members was relatively homogeneous. An outlier is also present as shown in Figure 6.16. Attention should be given to certain individual criteria.

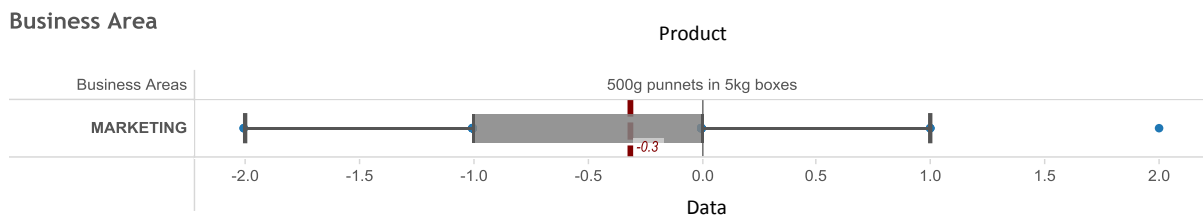


Figure 6.16: Marketing summary of punnet (n = 5).

6.3.1.2 **ENVIRONMENT IN TERMS OF PACKAGING REQUIREMENTS**

The box plots in Figure 6.17 are a summary of the data set of the environmental criteria for the 500 gram. The economy of resources generally underperformed with relation to its importance with $Q_1 = -3$ ($Q_1 < -1$) as indicated in Figure 6.17. The performance of the

packaging criteria was lower than the importance thereof. The environmental aspect of the punnets did not perform well with regard to importance with $Q_1 < -1$. The recycling process performed well with $Q_1 = -1$ as indicated in Figure 6.17.

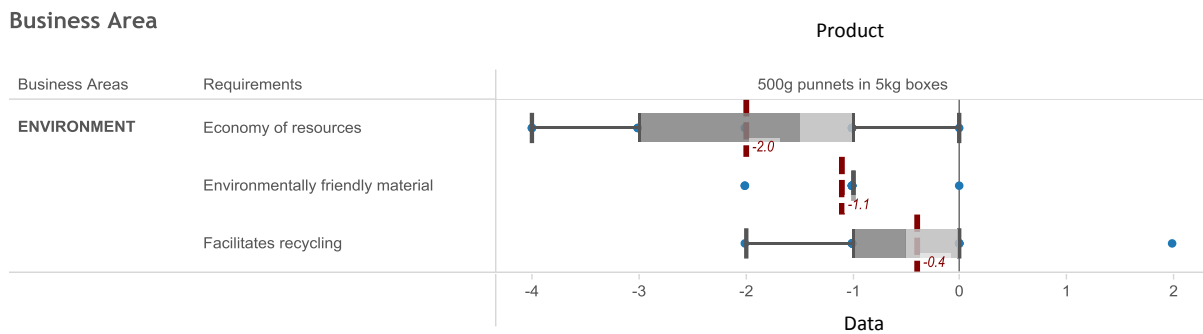


Figure 6.17: Environmental requirements for punnet (n = 5).

In general, the environmental criteria of the punnets underperformed (as indicated in Figure 6.18) with $Q_1 = -2$ and $Q_3 = -1$. The performance of the packaging criteria was lower than the importance thereof. The interquartile range ($Q_3 - Q_1 = 2$) is relatively large and indicates that the response of the supply chain members was relatively heterogeneous. Two outliers are also present as shown in Figure 6.18. Attention should be given to the economy of resources in order to make punnets more environmentally friendly.

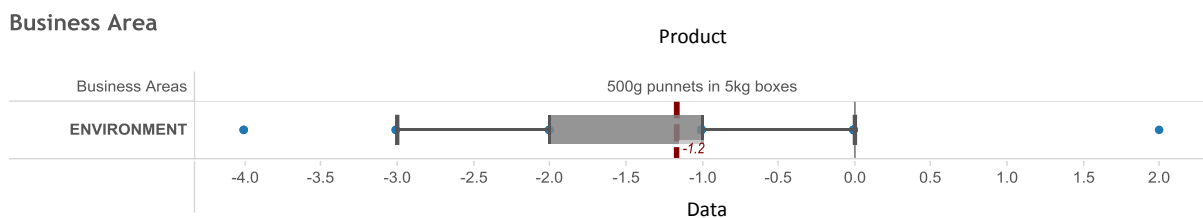


Figure 6.18: Environmental summary of punnet (n = 5).

6.3.1.3 LOGISTICS IN TERMS OF PACKAGING REQUIREMENTS

The box plots in Figure 6.19 are a summary of the data set of the logistics criteria for the 500 gram punnet. The correct amount and size in terms of logistics to perform generally well in relation to its importance with $Q_1 = -1$ as indicated in Figure 6.19. The packaging criteria was equal to the importance thereof. The packaging design of the punnet performed good with $Q_1 = -1$ as indicated in Figure 6.19. In general, the role players in the supply chain were also satisfied with the logistical information of the punnets with $Q_1 = -1$ as indicated in Figure 6.19. The punnets did not perform well regarding product protection with $Q_1 = -2$ ($Q_1 < -1$) as indicated in Figure 6.19. This is when the performance of the packaging criteria was lower than the importance thereof

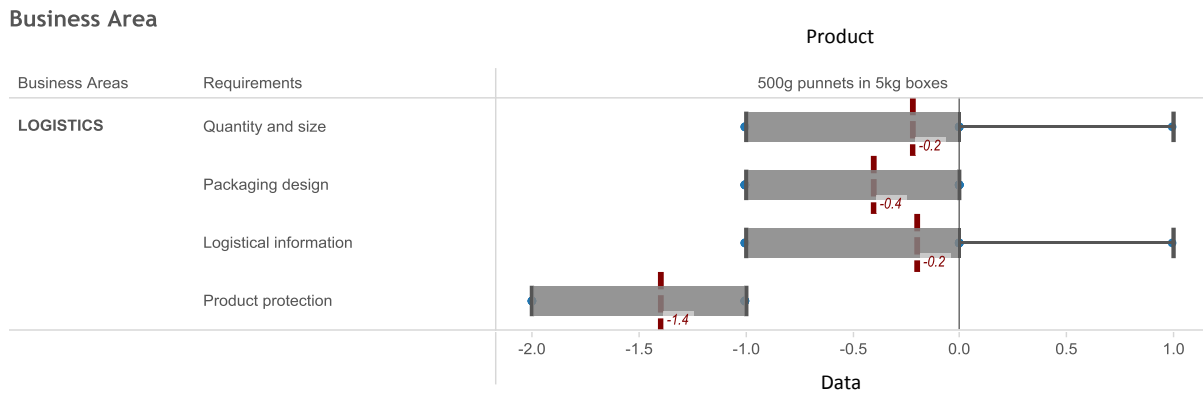


Figure 6.19: Logistical requirements for punnet (n = 5).

The logistics of the punnets generally performed well with $Q_1 = -1$ and $Q_3 = 0$ (as indicated in Figure 6.20). The interquartile range ($Q_3 - Q_1 = 1$) is relatively small and indicates that the response of the supply chain members was relatively homogeneous as shown in Figure 6.20. However, product protection of the punnet can be improved.

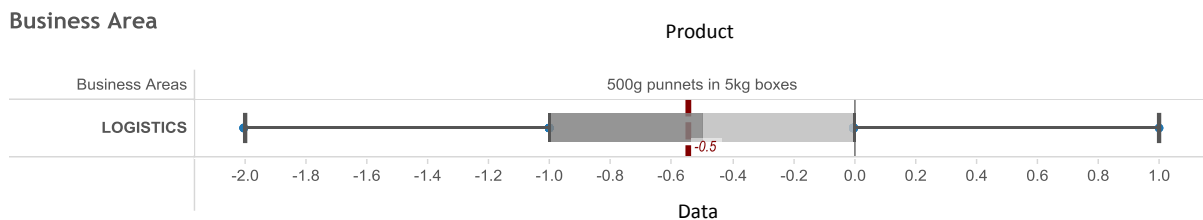


Figure 6.20: Logistical summary of punnet (n = 5).

6.3.2 SECONDARY PACKAGING: 5KG BOX

The overall performance of the 5kg box related to secondary packaging is indicated in Table 6.7. In general there was an under performance regarding the 5kg box as the median of importance (line) received a higher score than the median of performance (circle). The requirements for each business area of this packaging will be looked at individually.

MARKETING AS PACKAGING CRITERIA

The relevant supply chain members were satisfied with the recycling or disposal information and the directions for use of this packaging. However, the nutritional information did not perform well. The relevant role players in the supply chain were satisfied with the point of sale display of the packaging. The relevant role players in the supply chain were satisfied with the amount and size and the graphics and design of the packaging.

ENVIRONMENT AS PACKAGING CRITERIA

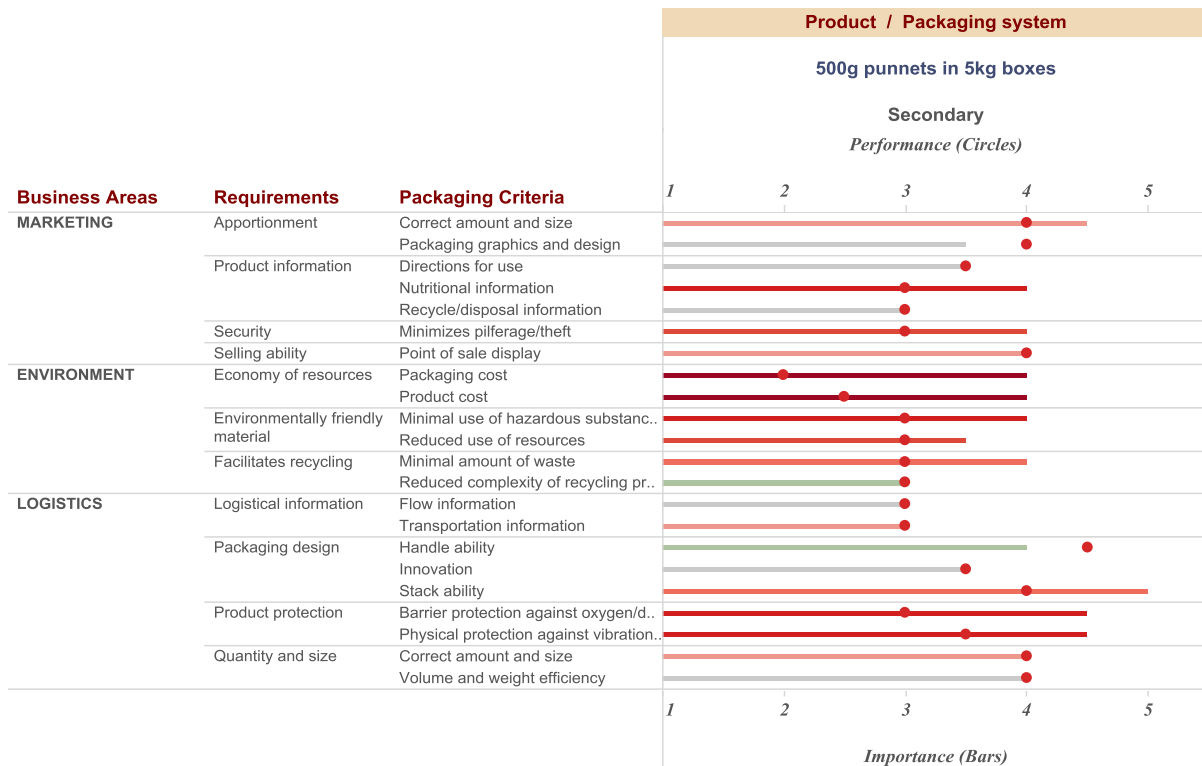
The relevant members of the supply chain were not satisfied with the packaging and product cost. According to the role players in the supply chain, the packaging inadequately reduces the use of resources and minimizes the use of hazardous substances. According to the members of the supply chain, the 5kg box reduces the complexity of the recycling process. However, the minimal amount of waste of the packaging did not perform well in relation to its importance.

LOGISTICS AS PACKAGING CRITERIA

In general, the relevant supply chain members were satisfied with the volume and weight and the amount and size in terms of logistics. The relevant role players in the supply chain were satisfied with innovation and handling ability. However, the stack ability of the packaging did not perform well in terms of importance. The flow and transport information satisfied the supply chain members in relation to the importance. The physical and barrier protection of the packaging underperformed in terms of its importance.

Table 6.7: Overall performance of 5kg box (Secondary Packaging).

Bullets & Bars



6.3.2.1 **MARKETING IN TERMS OF PACKAGING REQUIREMENTS**

The box plots in Figure 6.21 are a summary of the data set of the marketing criteria for the 5kg box. The 5kg boxes performed generally well in terms of product information with $Q_1 = -0.5$ as indicated in Figure 6.21. The performance of the packaging criteria was equal to the importance thereof. The 5kg box did not present a problem with selling ability with $Q_1 = -0.5$ as indicated in Figure 6.21. The security of the 5kg box generally underperformed with $Q_1 = -1$ as indicated in Figure 6.21. The packaging criteria were equal to the importance thereof. The overall apportionment of the 5kg box performed well with $Q_1 > -0.5$ as indicated in Figure 6.21.

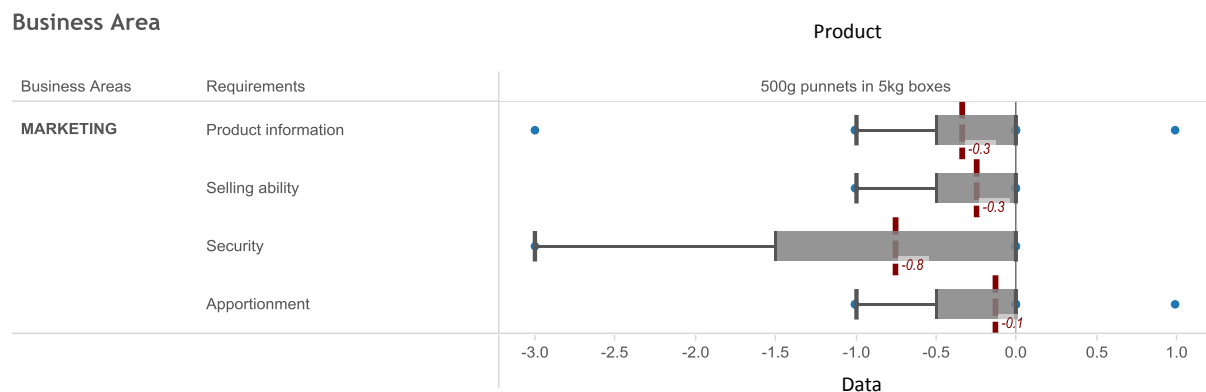


Figure 6.21: Marketing requirements for 5kg box (n = 4).

The marketing aspect of the 5kg box performed well with $Q_1 = -0.5$ and $Q_3 = 0$ (as indicated in Figure 6.22). Not much attention is needed to improve marketing for the 5kg box. The interquartile range ($Q_3 - Q_1 = 0.5$) is small and indicates that the response of the supply chain members was homogeneous. Two outliers are also present as shown in Figure 6.22.

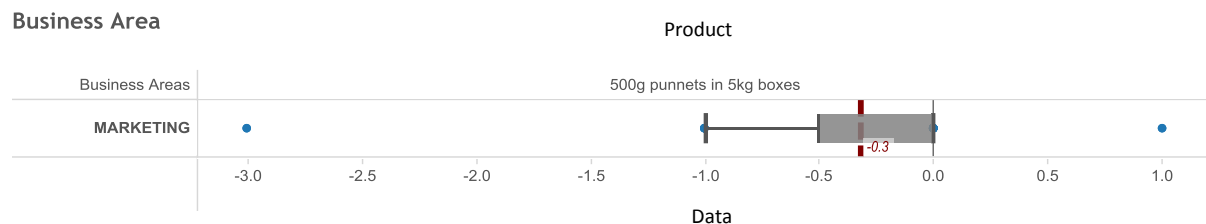


Figure 6.22: Marketing summary of 5kg box (n = 4).

6.3.2.2 **ENVIRONMENT IN TERMS OF PACKAGING REQUIREMENTS**

The box plots in Figure 6.23 are a summary of the data set of the environmental criteria for the 5kg box. The packaging and product cost is not economical with economy of resources that underperformed with $Q_1 = -3.5$ ($Q_1 < -1$) as indicated in Figure 6.23. The performance of the packaging criteria was lower than the importance thereof. The 5kg box did not perform

well from an environmental aspect with $Q_1 = -1.5$ ($Q_1 < -1$) as indicated in Figure 6.23. The 5kg box facilities recycling with $Q_1 = -0.5$ as indicated in Figure 6.23.

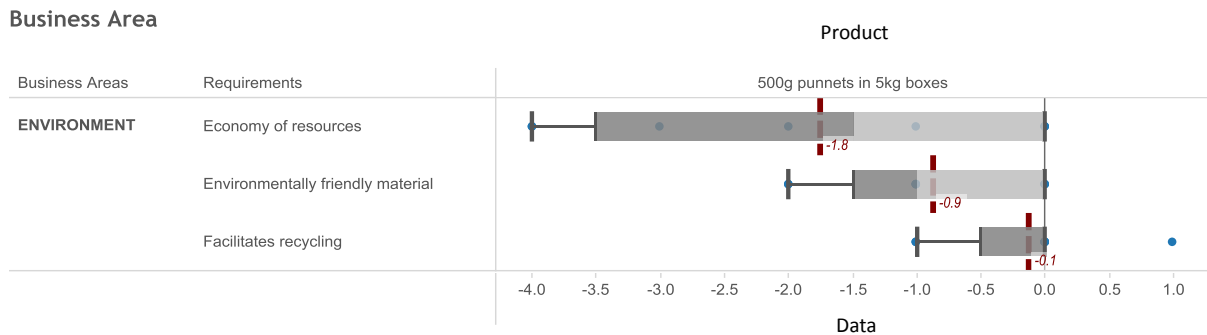


Figure 6.23: Environmental requirements for 5kg box (n = 4).

A general underperformance as indicated in Figure 6.24 occurred regarding the environmental aspect of the 5kg box with $Q_1 = -1.5$ ($Q_1 < -1$). The interquartile range ($Q_3 - Q_1 = 1.5$) is relatively large and indicates that the response of the supply chain members was relatively heterogeneous. An outlier is also present as shown in Figure 6.24. Attention should be given to the economy of resources in order to make the 5kg box more environmentally friendly.

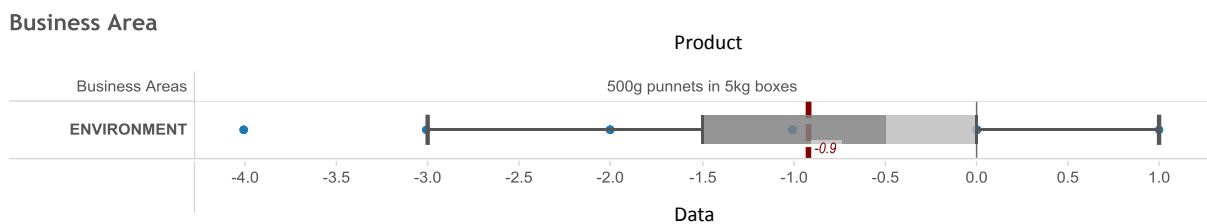


Figure 6.24: Environmental summary of 5kg box (n = 4).

6.3.2.3 LOGISTICS IN TERMS OF PACKAGING REQUIREMENTS

The box plots in Figure 6.25 are a summary of the data set of the logistics criteria for the 5kg box. The 5kg box performed well regarding quantity and size with $Q_1 = 0$ as indicated in Figure 6.25. The performance of the packaging criteria was equal to the importance thereof. In general, the packaging design of the 5kg box performed well with $Q_1 = 0$ as indicated in Figure 6.25. The overall logistical information of the 5kg box also performed well with $Q_1 = 0$ as indicated in Figure 6.25. The performance of the packaging criteria was equal to the importance thereof. The relevant members in the supply chain indicated that the product protection of the 5kg box was generally not satisfactory $Q_1 = -2$ ($Q_1 < -1$) as indicated in Figure 6.25. This is when the performance of the packaging criteria was lower than the importance thereof.

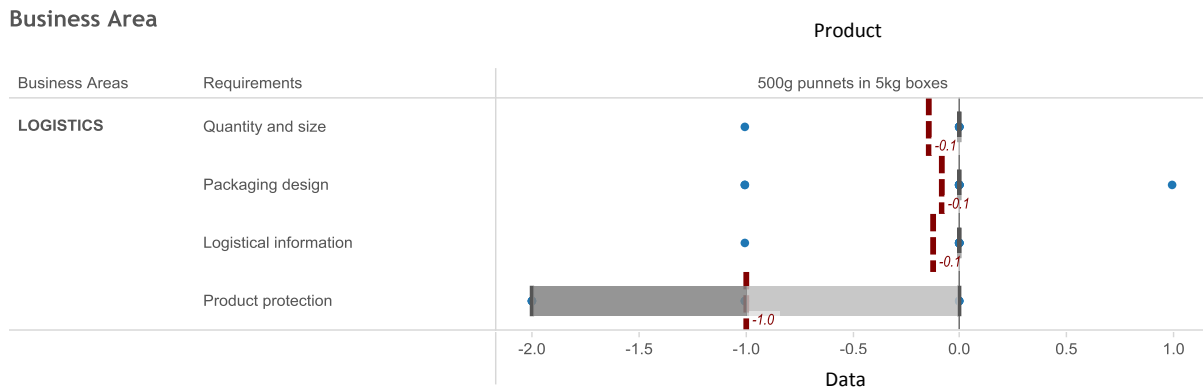


Figure 6.25: Logistical requirements for 5kg box (n = 4).

Overall, the logistics of the 5kg box performed well with $Q_1 = -1$ and $Q_3 = 0$ (as indicated in Figure 6.26). The interquartile range ($Q_3 - Q_1 = 1$) is relatively small and indicates that the response of the supply chain members was relatively homogeneous as shown in Figure 6.26. Therefore, not much attention is needed in order to improve the logistics of the 5kg box.

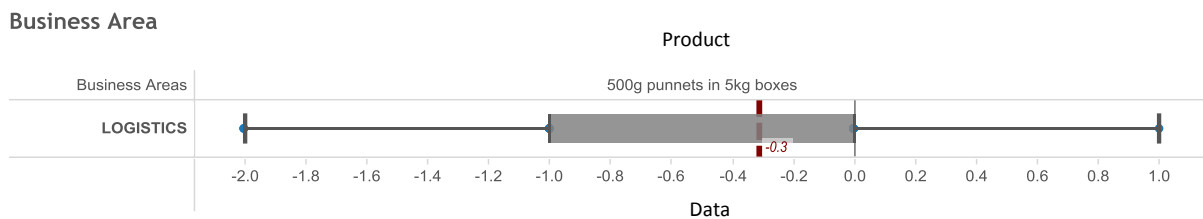


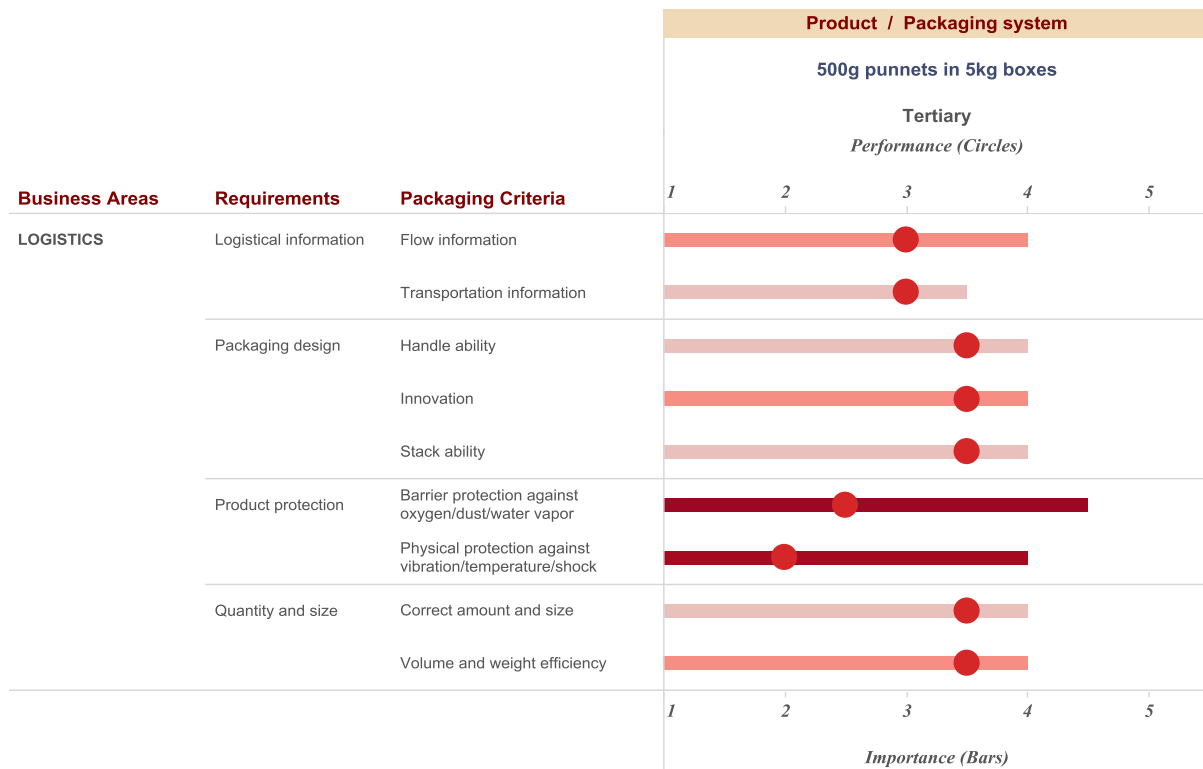
Figure 6.26: Logistical summary of 5kg box (n = 4).

6.3.3 TERTIARY PACKAGING: BOXES STACKED ON PALLET AND WRAPPED

The overall performance of the boxes stacked on pallet and wrapped related to tertiary packaging is indicated in Table 6.8. In general there was an under performance regarding the boxes stacked on a pallet and wrapped as the median of importance (line) received a higher score than the median of performance (circle). The requirements for each business area of this packaging will be looked at individually.

Table 6.8: Overall performance of boxes stacked on pallet and wrapped (Tertiary Packaging).

Bullets & Bars



LOGISTICS AS PACKAGING CRITERIA

The amount and size and the volume and weight efficiency performed relatively well in terms of importance. However, this requirement can still be improved. Overall, the relevant role players in the supply chain were satisfied with the handling and stacking ability of the 5kg boxes on the pallet. The innovation of the 5kg box underperformed slightly. The flow and transport information on the packaging did satisfy the supply chain members to a certain extent, but the logistical information of the 5kg boxes can still be improved. The physical and barrier protection of the packaging also underperformed in terms of importance.

6.3.3.1 LOGISTICS IN TERMS OF PACKAGING REQUIREMENTS

The box plots in Figure 6.27 are a summary of the data set of the logistics criteria for the boxes stacked on a pallet and wrapped. The quantity and size of the packaging proved to be generally satisfactory to the members of the supply chain with $Q_1 = -1$ as indicated in Figure 6.27. The performance of the packaging criteria was equal to the importance thereof. The packaging performed relatively well in terms of packaging design with $Q_1 = -1$ as indicated in

Figure 6.27. The logistical information performed relatively well with $Q_1 = -1$ as indicated in Figure 6.27. According to the relevant role players within the supply chain, the product protection of the packaging proved to be unsatisfactory with $Q_1 = -3$ ($Q_1 < -1$). This is when the performance of the packaging criteria was lower than the importance thereof

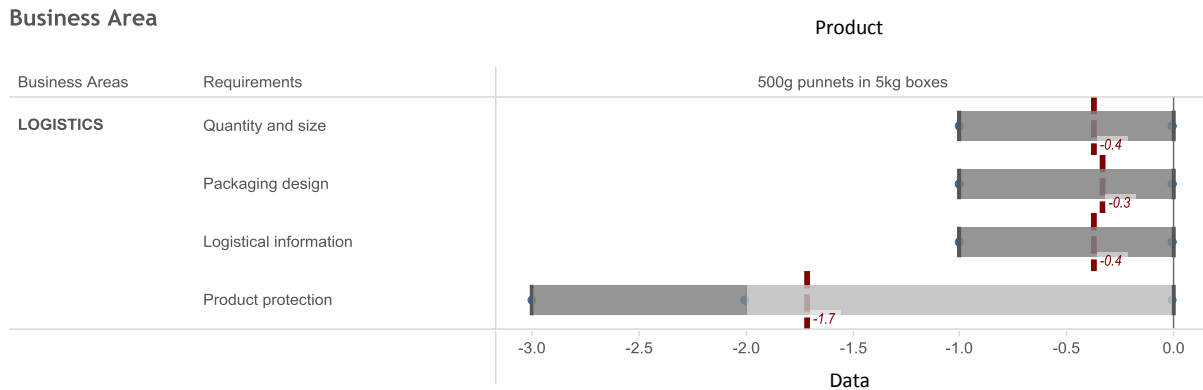


Figure 6.27: Logistical requirements for boxes stacked on pallet (n = 4).

In general, the logistics of the packaging performed relatively well with $Q_1 = -1$ and $Q_3 = 0$ (as indicated in Figure 6.28). The interquartile range ($Q_3 - Q_1 = 1$) is relatively small and indicates that the response of the supply chain members was relatively homogeneous. An outlier is also present as shown in Figure 6.28. Product protection can be improved.

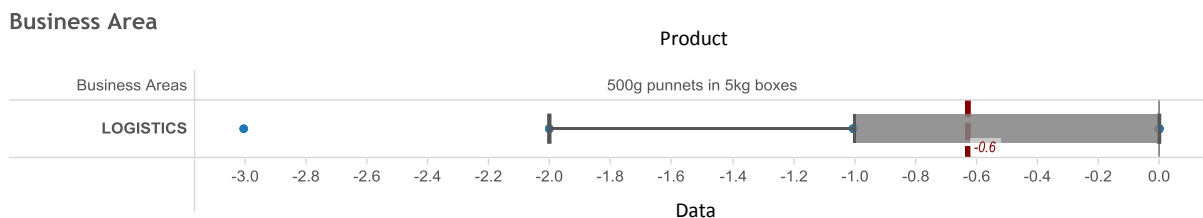
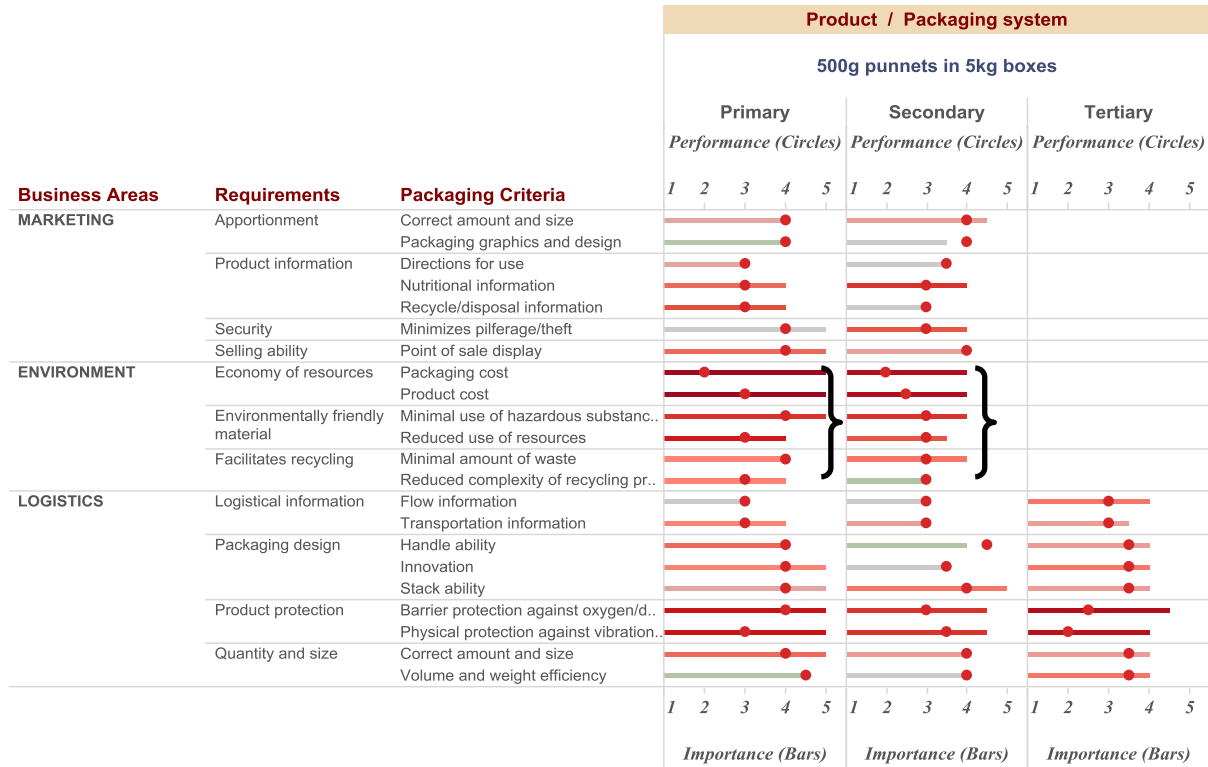


Figure 6.28: Logistical summary of boxes stacked on pallet (n = 4).

The overall performance of the 5kg is indicated in Table 6.9. In general there was an underperformance regarding the different packaging criteria. The specific areas that underperformed significantly are the environmental aspect of the 500g punnet and the 5kg box.

Table 6.9.: Overall performance of 5kg box with the 500g punnets.

Bullets & Bars



6.4 SUMMARY

After analysing the data collected it is evident that there are many aspects of the different packaging levels that should be improved. As indicated in Figure 6.29 the marketing of the plastic bag underperformed. This was due to a relatively large underperformance of the nutritional information of the bag, the plastic bag also fails to minimize pilferage and theft and the amount and size of the plastics bag was also unsatisfactory. The logistics of the plastic bag also underperformed this was due to the underperformance of the handling and stacking ability of the plastic bag and the physical and barrier protection of the plastic bag. The environmental aspect of the 4.5kg box also underperformed and this was due to the underperformance of the packaging and product cost and it was unsatisfactory with regard to the reduced use of resources and the minimal use of hazardous substances. The amount of waste during the recycling process was also a problem. The logistical information of the 4.5kg box over performed due to the over performance of the flow information of the packaging. This indicates that there is too much resource invested in logistical information

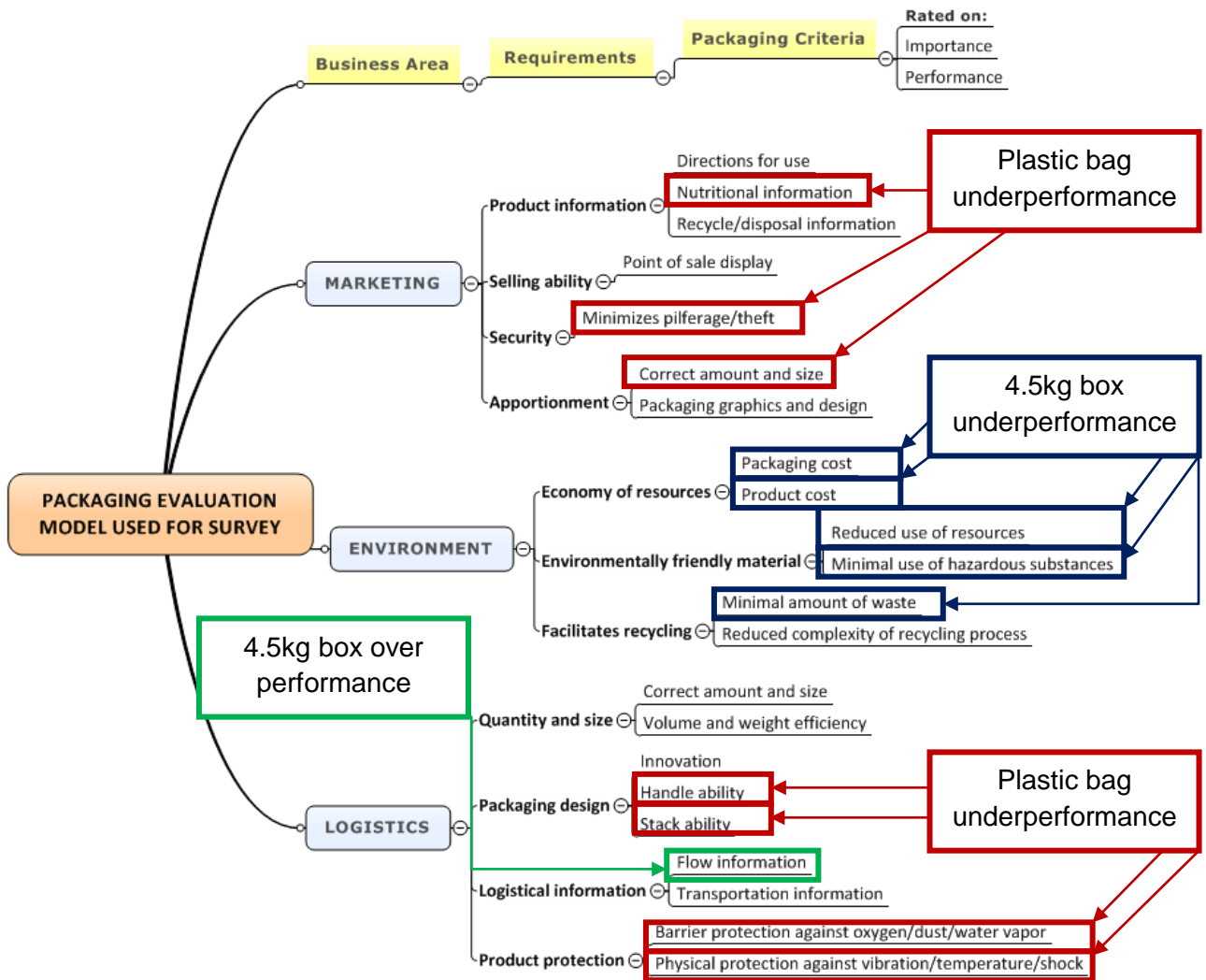


Figure 6.29: Underperformance summary of the 4.5kg box with grapes in plastic bags.

As indicated in Figure 6.30 the environmental aspect of the 500g punnet underperformed. This was due to the underperformance of the packaging and product costs. The 500g punnet also did not reduce the use of resources or minimize the use of hazardous substances. In general there was also an underperformance regarding the environmental aspect of the 5kg box. This was mainly due to the underperformance of the packaging and product cost. The 5kg box inadequately reduces the use of resources and minimizes the use of hazardous substances. The amount of waste of the packaging also did not perform well. Possible solutions should be explored in order to address these problems. The packaging graphics and design and the handle ability of the 5kg box over performed. Therefore, fewer resources should be invested in the above mentioned criteria of the 5kg box.

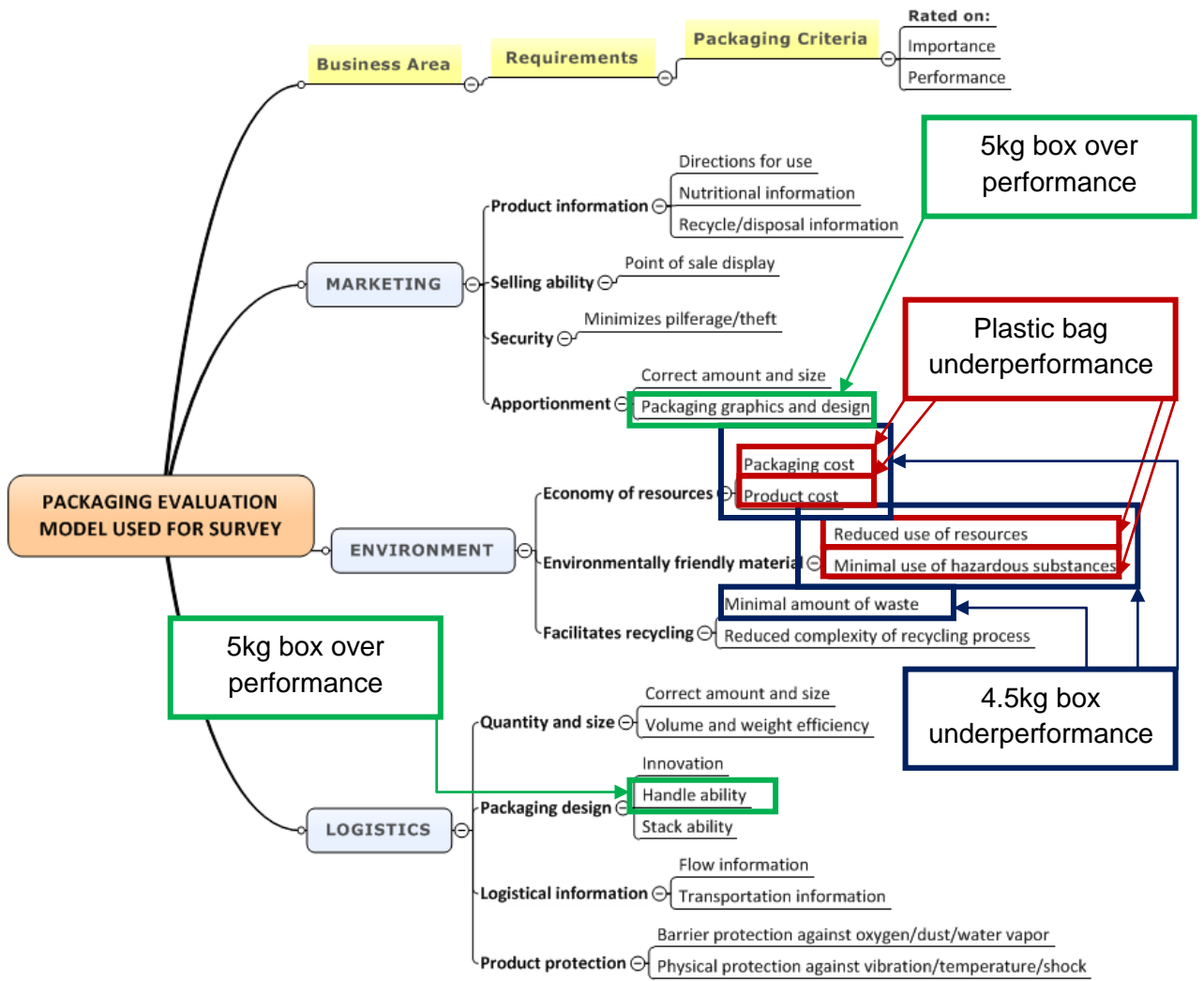


Figure 6.30: Underperformance summary of the 5kg box with grapes in 500g punnets.

CHAPTER 7: POSSIBLE SOLUTIONS

The possible solutions in the form of the relevant and the current packaging innovations will be explored in this Chapter. The packaging innovation will be divided into innovation of one level in the packaging system or innovation of inner packaging materials. Possible solutions or improvements will be proposed in order to address the current problems in the packaging systems.

7.1 PACKAGING INNOVATION IN THE INDUSTRY

Packaging innovation has the potential to add value and promote sales (Young, 2004). According to Young (2004) packaging innovation has the opportunity to differentiate the product and could therefore give it a competitive advantage. Therefore, packaging innovation can be used to improve the current packaging of South African table grapes. Current research regarding packaging is either on the inner packaging material or it can be on the entire packaging system. Therefore, packaging innovation can be divided into two sections i.e. inner packaging material and the complete packaging system as illustrated in Figure 7.1.

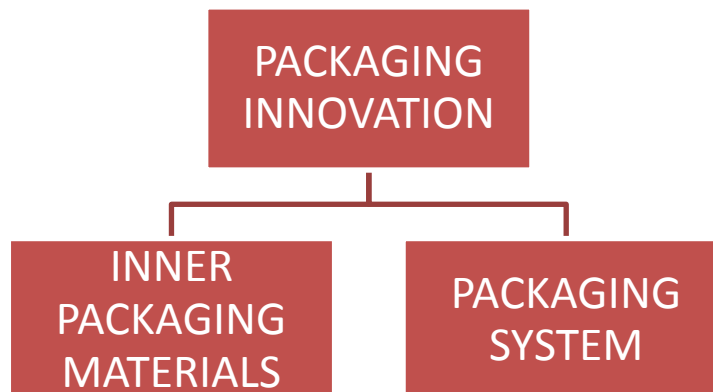


Figure 7.1: Packaging Innovation.

7.2 INNER PACKAGING MATERIALS

7.2.1 PERFORATED PLASTIC LINERS

During transport table grapes are subject to severe water loss and decay (Lichter, Zutahy, Kaplunov & Lurie, 2008). Pads are positioned over the grapes during transportation in order to prevent or limit damage (Lichter *et al.*, 2008). Sulphur dioxide (SO₂), the chemical used to

control decay and mould in grapes, is released from these pads (Lichter *et al.*, 2008). Currently there are two main methods of packaging used in the transportation of grapes:

- a) A perforated plastic liner is placed on the inside of the box, grapes are placed in this liner and then it is cooled.
- b) Boxed grapes are cooled and then the entire pallet of boxes is externally wrapped.

In both methods of packaging sulphur dioxide (SO₂) pads are positioned over the grapes (Lichter *et al.*, 2008). Recent research of the Department of Postharvest Science at the Agricultural Research Organisation of Israel's Volcani Centre compared the two packaging methods (Lichter *et al.*, 2008).

The study involved table grapes packed in cardboard and plastic boxes. The quality of grapes in the plastic boxes was generally similar in both packaging methods while slightly better results regarding externally wrapped pallets occurred (Lichter *et al.*, 2008).

The quality of grapes in the cardboard boxes was significantly lower, as lower levels of sulphur dioxide (SO₂) were reported in externally wrapped pallets (Lichter *et al.*, 2008). Higher levels of sulphur dioxide (SO₂) absorption by cardboard resulted in the quality of grapes being lower in externally wrapped pallets (Lichter *et al.*, 2008). The grapes in the perforated plastic liner had a slightly higher level of quality as it retained higher levels of sulphur dioxide (SO₂) (Lichter *et al.*, 2008).

The packaging method that is generally used for long distance transportation is the packaging of grapes in perforated plastic liners (Lichter *et al.*, 2008). The study concluded that the use of external pallet wrapping with low-density polyethylene film can promote effective packaging, as it presents significant advantages (Lichter *et al.*, 2008):

- a) Pre-cooling of grapes is faster.
- b) This method of packaging is more cost effective.

The use of recyclable plastic boxes with external pallet wrapping will prevent the absorption of sulphur dioxide (SO₂) and it will have a more positive effect on the environment (Lichter *et al.*, 2008).

7.2.2 SULPHUR DIOXIDE LINER BAG

Transportation and storage of many horticultural products are difficult due to the growth of moulds (Christie, 2001). To assist in the storage and transportation of table grapes for any length of time a fungicide treatment is required to delay the growth of mould. Sulphur dioxide (SO_2) is the fungicide treatment generally used in the grape industry (Christie, 2001).

Horticulture Australia Limited developed a new packaging material for use in exporting table grapes in order to prevent or limit damage caused by the growth of mould (Christie, 2001). A new liner bag, which releases sulphur dioxide (SO_2), will replace the current sulphur dioxide (SO_2) pads currently used in the industry. A controlled release polymer has been developed, which forms part of the new liner bag (Christie, 2001). The new liner bag releases sulphur dioxide (SO_2) at lower levels than the pad technology currently used in the industry (Christie, 2001). If sulphur dioxide (SO_2) levels are too high bleaching of the grape tissue occurs as showed in Figure 7.2.



Figure 7.2: Bleaching of grape tissue (Christie, 2001)

According to Christie (2001) bleaching results in reduced prices for grapes. Another negative effect of high sulphur dioxide (SO_2) levels in foods is the sensitivity that a portion of the world has towards sulphites in foods. The new liner bag reduces the presence of bleaching and sulphite residues by controlling the levels of sulphur dioxide (SO_2) that grapes are exposed to (Christie, 2001). Therefore, it has the ability to control the growth of mould for approximately five weeks and it is also less susceptible towards temperature fluctuations during transportation (Christie, 2001).

7.2.3 VINGUARD™

South African table grapes spend an average of four weeks in transit and a week in cold storage at the market before it is sold (Limson & Cambray, 2002). Bleaching of the grape tissue is the main reason for deterioration of fruit quality during transportation and storage (Opperman, Fourie, Sanderson & Britz, 1999). Therefore, sulphur dioxide (SO₂) pads or sheets are used in order to prevent or limit damage (Limson & Cambray, 2002). In South Africa, however, the high cost of locally manufactured and imported sulphur dioxide (SO₂) pads or sheets, strict food legislation and changing export requirements encouraged the development of a new sulphur dioxide (SO₂) sheet (Vinguard™) as shown in Figure 7.3 (Limson & Cambray, 2002).



Figure 7.3: Sulphur Dioxide (SO₂) sheet (Vinguard™) (Limson & Cambray, 2002).

The VINGUARD™ releases sulphur dioxide (SO₂) once it comes into contact with high levels of moisture that is present in the packaging of grapes (Opperman *et al.*, 1999). A main advantage of the VINGUARD™ is flexibility in terms of shape and size and the ease in which the levels of sulphur dioxide (SO₂) can be adjusted (Limson & Cambray, 2002). The VINGUARD™ is available in different sizes (Opperman, 2009):

- a) DR 3040-14 (30 cm x 40 cm and 30 cm x 50 cm boxes)
- b) DR 6040-14 (60 cm x 40 cm boxes)
- c) DR 4540-14 (5kg punnet boxes)

Therefore, the VINGUARD™ has the ability to control the occurrence of bleaching and sulphite residues in different sizes in terms of packaging by controlling the levels of sulphur dioxide (SO₂) that grapes are exposed to.

7.3 PACKAGING SYSTEM

7.3.1 THE NEW GENERATION PACK (NGP)

The New Generation Pack (NGP) is an innovative packaging material used to wrap fruit packed in punnets (REV Packaging Solutions, 2011). According to REV Packaging Solutions (2011) the packaging material consists of a tubular extruded net which is wrapped around a punnet as shown in Figure 7.4. Two bands of film are used to supply information regarding the contents of the punnet (REV Packaging Solutions, 2011).



Figure 7.4: New Generation Pack (NGP) (REV Packaging Solutions, 2011).

The New Generation Pack (NGP) presents advantages. The main advantages include (REV Packaging Solutions, 2011):

- a) The NGP is more environmentally friendly as shown in Table 7.1.
- b) The NGP has a strong visual impact
- c) The NGP promotes ventilation.
- d) The contents of the NGP is highly visible
- e) The NGP technology can be used on different punnets in terms of size and shape.
- f) The specifications of the NGP, as shown in Table 7.1, promote cost effectiveness.

The specifications of the New Generation Pack (NGP) in Table 7.1 shows significant advantages compared to the traditional metal clip packaging (REV Packaging Solutions, 2011).

Table 7.1: New Generation Pack (NGP) specifications (REV Packaging Solutions, 2011).

	NGP PACKAGING	TRADITIONAL METAL CLIP PACKAGING
Materials	Upper band, customisable (28.5cm – 3509/Km) Lower Band, Neutral (29.5cm – 3390/Km) Net (30cm – 3333/Km) Printing Ribbon (printing length 6cm)	Net (32cm – 3125/Km) Handle Band 12mm (32cm – 3125/Km) Metal Plate 5 x 0.35 mm (0.5g) Wineglass label 38 x 145mm
Weight of Packaging	2.4g	3.0g
Plastic used to produce 20,000 packs	48kg	60kg
Quantity of plastic introduced into the environment	-20% (compared to traditional metal clip packaging)	+25% (compared to NGP)
Cost as a percentage	With NGP SAVE UP TO 5.6% (compared to traditional metal clip packaging)	ADDITIONAL costs compared to NGP +6%

7.3.2 EASYPUNNET

The Easypunnet is an innovative packaging method that offers a high impact pack for punnets that is wrapped in extruded net and film (Sorma Group, 2012). The Easypunnet is wrapped around the punnet with film on three sides with extruded net on top of the punnet (Sorma Group, 2012). It is available in two versions i.e.

- a) Easypunnet Standard (Figure 7.5): The top of the punnet is completely covered in extruded net (Sorma Group, 2012).
- b) Easypunnet Superplus (Figure 7.6): The extruded net is welded to two bands of film that can be printed on and is visible from above (Sorma Group, 2012).



Figure 7.5: Easypunnet Standard (Sorma Group, 2012).



Figure 7.6: EasyPunnet Superplus (Sorma Group, 2012).

The EasyPunnet provides several advantages that include:

- a) **Marketing:** The EasyPunnet offers space for communication in order to provide product and brand information (Sorma Group, 2012). The film is available in a clear version and can be printed on in eight different colours with the extruded net available in all colours (Sorma Group, 2012).
- b) **Environmental:** The material used for EasyPunnet is 100% recyclable (Sorma Group, 2012).
- c) **Ventilation:** The EasyPunnet promotes airflow (Sorma Group, 2012) through the use of extruded netting.
- d) **Flexible:** The EasyPunnet is flexible, as it can be used for a wide variety of fruits (Sorma Group, 2012). The size of the EasyPunnet varies from 250 grams to 2 kg (Sorma Group, 2012).

7.3.3 TALI GRAPE BASKET

The World Packaging Organisation (WPO) annually hosts the Worldstar awards for packaging excellence. The Worldstar awards promote the objectives of the World Packaging Organisation (WPO). These objectives include (World Packaging Organisation, 2007):

- a) Encourage the development of packaging technology, science, access and engineering
- b) Contribute to the development of international trade
- c) Stimulates education and training in packaging.

The Grape Basket of Tali Grapes in Israel shown in Figure 7.7 received an award at the Worldstar awards for packaging excellence in 2002 (Haberfeld, 2003).



Figure 7.7 Grape Basket (Haberfeld, 2003).

The Grape Basket is an innovative packaging method and offers the following advantages (Haberfeld, 2003):

- a) The basket offers easy handling.
- b) Grapes can be washed and stored while in the basket.
- c) The basket protects grapes when stacked on each other during transportation and storage as shown in Figure 7.7.
- d) The basket allows ventilation and promotes a longer shelf life.

According to Mr Ivri (2012) of Tali Grapes, this method of packaging is used for the local market in Israel. For transportation and storage purposes six Grape Baskets are placed in a carton box and forty eight of these carton boxes are stacked on a pallet as shown in Figure 7.8 (Ivri, 2012).



Figure 7.8: Secondary packaging of Grape Baskets (Ivri, 2012).

However, there are two major challenges with the use of the Grape Basket (Ivri, 2012)

- a) Economical: Cost of packaging (variable and fixed) is high (Ivri, 2012). According to Ivri (2012) the production cost is approximately R1 40 per Grape Basket. The premium ability is limited. Therefore, high volumes of packaging are necessary for mass production purposes (Ivri 2012).
- b) Mass: The mass of the contents is limited due to the mass of the Grape Basket (Ivri , 2012).

7.4 SUMMARY

The above mentioned innovations in the industry can be used as foundation for improvements to the problems in the packaging systems. Entire packaging innovations or certain aspects can be applied to problem areas in the packaging system.

CHAPTER 8: CONCLUSION AND RECOMMENDATIONS

After the data collection and analysis possible solutions of recommendations should be made. Conclusions and recommendations will be made according to the packaging innovation in the industry as discussed in Chapter 7.

As discussed in Chapter 5 the new questionnaire used during the evaluation process of the packaging measured the performance of the packaging requirements in relation to the importance thereof. An underperformance indicated that the score received for performance was lower than the score received for importance. Subsequently, a good performance was when the score received for performance was equal or higher than the score received for importance thereof.

The box plots that were used indicated this level of performance. As discussed in Chapter 6, if the first quartile (Q_1) of a certain packaging requirement or business area was -1 or more it was regarded as a good performance. Subsequently, if first quartile (Q_1) of a certain packaging requirement or business area was less than -1 it was regarded as an underperformance and should be improved.

If the third quartile (Q_3) of a certain packaging requirement or business area was a value of 0 or less it was regarded as a good performance. Subsequently, if the third quartile (Q_3) of a certain packaging requirement or business area received a value more than 0 it was regarded as an over performance and should also receive attention as too much resources could possibly be invested in the particular packaging requirement or business area.

The data visualization of the packaging performance against the importance thereof in Chapter 6, assisted to determine the problem areas within the packaging system. Then the individual requirements for each business area in each level of the packaging system were evaluated to determine the source of underperformance or over performance. During the evaluation of the two types of packaging it became evident to the relevant role players in the supply chain that there are several areas where the packaging did not meet the requirements.

Table 8.1 indicates a summary of the different business areas of the two types of packaging which underperformed according to Chapter 6. It was clear that the major problem areas of both packaging systems involved were related to the environmental aspect of the packaging.

The marketing and the logistics of the plastic bag also underperformed. However, individual criteria regarding the other business areas can also be improved.

Table 8.1: Summary of the performance of business areas

TYPE OF PACKAGING	PRIMARY			SECONDARY			TERTIARY
	Marketing	Environmental	Logistics	Marketing	Environmental	Logistics	Logistics
A04I: 4.5KG BOX WITH THE GRAPES IN PLASTIC BAGS	Under-performance ($Q_1 < -1$)		Under-performance ($Q_1 < -1$)		Under-performance ($Q_1 < -1$)		
A05E: 5KG (10 X 500G PUNNETS)		Under-performance ($Q_1 < -1$)			Under-performance ($Q_1 < -1$)		

Table 8.2 indicates possible solutions as discussed in Chapter 7 for the different problem areas within the different packaging systems. The possible solutions suggest one or more new types of packaging within the packaging system. However, the solutions suggested can also be used as inspiration to adapt certain elements in the current packaging systems in use. The New Generation Pack (NGP) serves as a possible primary packaging improvement for the marketing and environmental aspect. The NGP is more environmentally friendly regarding the materials used and has a strong visual impact (REV Packaging Solutions, 2011). The Easypunnet also serves as a possible primary packaging improvement for the marketing and environmental aspect. The Easypunnet has space for branding and product information. The material used for the Easypunnet is also 100% recyclable (Sorma Group, 2012). The Tali Grape basket serves as a possible primary packaging improvement for the logistics aspect. It protects grapes when stacked on each other during transportation and storage and also offers easy handling (Ivri, 2012).

The perforated plastic liners (in a plastic box) serve as a possible secondary packaging solution or improvement for the environmental aspect. According to Lichter *et al.* (2008) the use of recyclable plastic boxes with external pallet wrapping will prevent the absorption of sulphur dioxide (SO_2) and it will have a more positive effect on the environment. Vanguard™ serves as possible secondary packaging solution for the logistics aspect. According to Opperman, Fourie, Sanderson and Britz (1999) bleaching of grape tissue is one of the main reasons for deterioration of fruit quality during transportation and storage. Therefore, Vanguard™ are used in order to prevent or limit bleaching of the grape tissue (Opperman, 2009). The Sulphur Dioxide Liner Bag also serves as possible secondary packaging solution for the logistics aspect. This bag also reduces the presence of bleaching and sulphite

residues by controlling the levels of sulphur dioxide (SO₂) that table grapes are exposed to (Christie, 2001).

Table 8.2: Possible solutions for problem areas within the two packaging systems.

TYPE OF PACKAGING	PRIMARY			SECONDARY			TERTIARY
	Marketing	Environmental	Logistics	Marketing	Environmental	Logistics	Logistics
A04I: 4.5KG BOX WITH THE GRAPES IN PLASTIC BAGS	THE NEW GENERATION PACK (NGP) OR EASYPUNNET		TALI GRAPE BASKET		PERFORATED PLASTIC LINERS (PLASTIC BOX)	VINGUARD™ OR SULPHUR DIOXIDE LINER BAG	
A05E: 5KG (10 X 500G PUNNETS)		THE NEW GENERATION PACK (NGP) OR EASYPUNNET			PERFORATED PLASTIC LINERS (PLASTIC BOX)		

The different departments of the business should work together when innovating and improving the relevant packaging. This will enable the business to innovate and improve the current packaging without compromising the requirements for certain departments.

The improvement of the above mentioned problem areas will be beneficial to Dole South Africa and all the other members in the supply chain. The packaging systems would perform better in terms of the three business areas, i.e. marketing, environmental and logistics (as mentioned in 3.2). Understanding the interaction of these business areas within the packaging system improves the knowledge on the performance of packaging. This is very valuable for all the members in the supply chain and can also improve the competitiveness in the international and local packaging industry.

More effective and efficient packaging would reduce quality related problems regarding the table grapes and would also reduce costs. Packaging would also be more environmentally friendly with reduced waste in terms of packaging material. The movement of the packaging would be more effective and efficient which can also be regarded as a cost saving opportunity.

The research also contributes to the packaging development process as the demands or requirements for all the members of the supply chain regarding the packaging system are measured and can be used by the packaging designers. The packaging system can therefore be developed to be in line with the logistics system of the relevant supply chain.

Ultimately, this will enable the supply chain to supply an adequate product to the end customer.

8.1 FUTURE RESEARCH

This study contributes to the development of Packaging Logistics research. This study shows an understanding in terms of the interaction of the packaging system with the different members of the supply chain and the development of a questionnaire to evaluate the performance and importance of these interactions.

The outcome of this study can be used as a basis for future research. The possible solutions proposed, following the conclusions made, can be tested. Alternatively, new solutions or alterations to the current packaging can be made in order to improve the current problems related to the relevant packaging.

The new packaging evaluation questionnaire that was developed in this study can also be used to evaluate any other packaging system or even more complex packaging systems. Ongoing research can also be done to further test and improve the new questionnaire developed in this study.

Further research is also needed to improve the knowledge and understanding of the interactions between the different levels in the more complex packaging systems and the integrations between the packaging system and the different business areas. The interactions have a large impact on the performance of the packaging system.

The requirements for the packaging system as used in the new questionnaire can give packaging designers an insight into the required functions of the packaging system within the logistics process. This will enable the packaging decisions to be in line with the logistic decisions. This will not only improve the effectiveness and the efficiency of the supply chain, but it will also improve the up- and downstream communication between the members of the supply chain.

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ADDENDUM A: NEW QUESTIONNAIRE

PRIMARY PACKAGING

This survey evaluates the performance and importance of the primary packaging. Therefore, each criterion will be evaluated according to 1) performance and 2) importance.

Name *

Surname *

Company *

MARKETING

Product information

Nutritional information (performance)

*How satisfied are you with the nutritional information on the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Nutritional information (importance)

*How important is the nutritional information on the packaging for your use?

1 2 3 4 5

Not important

Very important

Recycle/disposal information (performance)

*How satisfied are you with the recycle/disposal information on the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Recycle/disposal information (importance)

*How important is the recycle/disposal information on the packaging for your use?

1 2 3 4 5

Not important

Very important

Directions for use (performance)

*How satisfied are you with the directions for use on the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Directions for use (importance)

*How important is the directions for use on the packaging for your use?

1 2 3 4 5

Not important

Very important

Selling ability

Point of sale display (performance)

*How satisfied are you with the point of sale display of the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Point of sale display (importance)

*How important is the point of sale display of packaging for your use?

1 2 3 4 5

Not important

Very important

Security

Minimizes pilferage/theft (performance)

*How satisfied are you with the pilferage/theft being minimized by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Minimizes pilferage/theft (importance)

*How important is the ability of packaging to minimize pilferage/theft for your use?

1 2 3 4 5

Not important

Very important

Apportionment

Correct amount and size (performance)

*How satisfied are you with the correct amount and size of the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Correct amount and size (importance)

*How important is the correct amount and size of the packaging for your use?

1 2 3 4 5

Not important

Very important

Packaging graphics and design (performance)

*How satisfied are you with of the graphics and design of the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Packaging graphics and design (importance)

*How important is the graphics and design of the packaging for your use?

1 2 3 4 5

Not important

Very important

ENVIRONMENT

Economy of resources

Packaging cost (performance)

*How satisfied are you with the cost of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Packaging cost (importance)

*How important is the cost of packaging for your use?

1 2 3 4 5

Not important

Very important

Product cost (performance)

*How satisfied are you with the product cost?

1 2 3 4 5

Not satisfied

Very satisfied

Product cost (importance)

*How important is the product cost for your use?

1 2 3 4 5

Not important

Very important

Environmentally friendly material

Reduced use of resources (performance)

*How satisfied are you with the resources being reduced by the packaging material?

1 2 3 4 5

Not satisfied

Very satisfied

Reduced use of resources (importance)

*How important is reduced use of resources for your use?

1 2 3 4 5

Not important

Very important

Minimal use of hazardous substances (performance)

*How satisfied are you with the hazardous substances being minimized by the packaging material?

1 2 3 4 5

Not satisfied

Very satisfied

Minimal use of hazardous substances (importance)

*How important is the minimal use of hazardous substances for your use?

1 2 3 4 5

Not important

Very important

Facilitates recycling

Minimal amount of waste (performance)

*How satisfied are you with waste being minimized by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Minimal amount of waste (importance)

*How important is the minimal amount of waste for your use?

1 2 3 4 5

Not important

Very important

Reduced complexity of recycling process (performance)

*How satisfied are you with the complexity of the recycling process being reduced by the packaging material?

1 2 3 4 5

Not satisfied

Very satisfied

Reduced complexity of recycling process (importance)

*How important is reduced complexity in recycling process for your use?

1 2 3 4 5

Not important

Very important

LOGISTICS

Quantity and size

Correct amount and size (performance)

*How satisfied are you with the correct amount and size of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Correct amount and size (importance)

*How important is the correct amount and size for your use?

1 2 3 4 5

Not important

Very important

Volume and weight efficiency (performance)

*How satisfied are you with the volume and weight efficiency of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Volume and weight efficiency (importance)

*How important is the volume and weight efficiency for your use?

1 2 3 4 5

Not important

Very important

Packaging design

Innovation (performance)

*How satisfied are you with the innovation of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Innovation (importance)

*How important is the innovation for your use?

1 2 3 4 5

Not important

Very important

Handle ability (performance)

*How satisfied are you with the handle ability of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Handle ability (importance)

*How important is the handle ability for your use?

1 2 3 4 5

Not important

Very important

Stack ability (performance)

*How satisfied are you with the stack ability of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Stack ability (importance)

*How important is the stack ability for your use?

1 2 3 4 5

Not important

Very important

Logistical information

Flow information (performance)

*How satisfied are you with the flow information of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Flow information (importance)

*How important is the flow information for your use?

1 2 3 4 5

Not important

Very important

Transportation information (performance)

*How satisfied are you with the transportation information of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Transportation information (importance)

*How important is the transportation information for your use?

1 2 3 4 5

Not important

Very important

Product protection

Physical protection against vibration/temperature/shock (performance)

*How satisfied are you with the physical protection by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Physical protection against vibration/temperature/shock (importance)

*How important is the physical protection for your use?

1 2 3 4 5

Not important

Very important

Barrier protection against oxygen/dust/water vapor (performance)

*How satisfied are you with the barrier protection by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Barrier protection against oxygen/dust/water vapor (importance)

*How important is barrier protection for your use?

1 2 3 4 5

Not important

Very important

SECONDARY PACKAGING

This survey evaluates the performance and importance of the secondary packaging. Therefore, each criterion will be evaluated according to 1) performance and 2) importance.

Name *

Surname *

Company *

MARKETING

Product information

Nutritional information (performance)

*How satisfied are you with the nutritional information on the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Nutritional information (importance)

*How important is the nutritional information on the packaging for your use?

1 2 3 4 5

Not important

Very important

Recycle/disposal information (performance)

*How satisfied are you with the recycle/disposal information on the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Recycle/disposal information (importance)

*How important is the recycle/disposal information on the packaging for your use?

1 2 3 4 5

Not important

Very important

Directions for use (performance)

*How satisfied are you with the directions for use on the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Directions for use (importance)

*How important is the directions for use on the packaging for your use?

1 2 3 4 5

Not important

Very important

Selling ability

Point of sale display (performance)

*How satisfied are you with the point of sale display of the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Point of sale display (importance)

*How important is the point of sale display of packaging for your use?

1 2 3 4 5

Not important

Very important

Security

Minimizes pilferage/theft (performance)

*How satisfied are you with the pilferage/theft being minimized by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Minimizes pilferage/theft (importance)

*How important is the ability of packaging to minimize pilferage/theft for your use?

1 2 3 4 5

Not important

Very important

Apportionment

Correct amount and size (performance)

*How satisfied are you with the correct amount and size of the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Correct amount and size (importance)

*How important is the correct amount and size of the packaging for your use?

1 2 3 4 5

Not important

Very important

Packaging graphics and design (performance)

*How satisfied are you with of the graphics and design of the packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Packaging graphics and design (importance)

*How important is the graphics and design of the packaging for your use?

1 2 3 4 5

Not important

Very important

ENVIRONMENT

Economy of resources

Packaging cost (performance)

*How satisfied are you with the cost of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Packaging cost (importance)

*How important is the cost of packaging for your use?

1 2 3 4 5

Not important

Very important

Product cost (performance)

*How satisfied are you with the product cost?

1 2 3 4 5

Not satisfied

Very satisfied

Product cost (importance)

*How important is the product cost for your use?

1 2 3 4 5

Not important

Very important

Environmentally friendly material

Reduced use of resources (performance)

*How satisfied are you with the resources being reduced by the packaging material?

1 2 3 4 5

Not satisfied

Very satisfied

Reduced use of resources (importance)

*How important is reduced use of resources for your use?

1 2 3 4 5

Not important

Very important

Minimal use of hazardous substances (performance)

*How satisfied are you with the hazardous substances being minimized by the packaging material?

1 2 3 4 5

Not satisfied

Very satisfied

Minimal use of hazardous substances (importance)

*How important is the minimal use of hazardous substances for your use?

1 2 3 4 5

Not important

Very important

Facilitates recycling

Minimal amount of waste (performance)

*How satisfied are you with waste being minimized by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Minimal amount of waste (importance)

*How important is the minimal amount of waste for your use?

1 2 3 4 5

Not important

Very important

Reduced complexity of recycling process (performance)

*How satisfied are you with the complexity of the recycling process being reduced by the packaging material?

1 2 3 4 5

Not satisfied

Very satisfied

Reduced complexity of recycling process (importance)

*How important is reduced complexity in recycling process for your use?

1 2 3 4 5

Not important

Very important

LOGISTICS

Quantity and size

Correct amount and size (performance)

*How satisfied are you with the correct amount and size of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Correct amount and size (importance)

*How important is the correct amount and size for your use?

1 2 3 4 5

Not important

Very important

Volume and weight efficiency (performance)

*How satisfied are you with the volume and weight efficiency of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Volume and weight efficiency (importance)

*How important is the volume and weight efficiency for your use?

1 2 3 4 5

Not important

Very important

Packaging design

Innovation (performance)

*How satisfied are you with the innovation of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Innovation (importance)

*How important is the innovation for your use?

1 2 3 4 5

Not important

Very important

Handle ability (performance)

*How satisfied are you with the handle ability of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Handle ability (importance)

*How important is the handle ability for your use?

1 2 3 4 5

Not important

Very important

Stack ability (performance)

*How satisfied are you with the stack ability of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Stack ability (importance)

*How important is the stack ability for your use?

1 2 3 4 5

Not important

Very important

Logistical information

Flow information (performance)

*How satisfied are you with the flow information of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Flow information (importance)

*How important is the flow information for your use?

1 2 3 4 5

Not important

Very important

Transportation information (performance)

*How satisfied are you with the transportation information of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Transportation information (importance)

*How important is the transportation information for your use?

1 2 3 4 5

Not important

Very important

Product protection

Physical protection against vibration/temperature/shock (performance)

*How satisfied are you with the physical protection by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Physical protection against vibration/temperature/shock (importance)

*How important is the physical protection for your use?

1 2 3 4 5

Not important

Very important

Barrier protection against oxygen/dust/water vapor (performance)

*How satisfied are you with the barrier protection by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Barrier protection against oxygen/dust/water vapor (importance)

*How important is barrier protection for your use?

1 2 3 4 5

Not important

Very important

TERTIARY PACKAGING

This survey evaluates the performance and importance of the tertiary packaging. Therefore, each criterion will be evaluated according to 1) performance and 2) importance.

Name *

Surname *

Company *

ENVIRONMENT

Economy of resources

Packaging cost (performance)

*How satisfied are you with the cost of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Packaging cost (importance)

*How important is the cost of packaging for your use?

1 2 3 4 5

Not important

Very important

Product cost (performance)

*How satisfied are you with the product cost?

1 2 3 4 5

Not satisfied

Very satisfied

Product cost (importance)

*How important is the product cost for your use?

1 2 3 4 5

Not important

Very important

Environmentally friendly material

Reduced use of resources (performance)

*How satisfied are you with the resources being reduced by the packaging material?

1 2 3 4 5

Not satisfied

Very satisfied

Reduced use of resources (importance)

*How important is reduced use of resources for your use?

1 2 3 4 5

Not important

Very important

Minimal use of hazardous substances (performance)

*How satisfied are you with the hazardous substances being minimized by the packaging material?

1 2 3 4 5

Not satisfied

Very satisfied

Minimal use of hazardous substances (importance)

*How important is the minimal use of hazardous substances for your use?

1 2 3 4 5

Not important

Very important

Facilitates recycling

Minimal amount of waste (performance)

*How satisfied are you with waste being minimized by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Minimal amount of waste (importance)

*How important is the minimal amount of waste for your use?

1 2 3 4 5

Not important

Very important

Reduced complexity of recycling process (performance)

*How satisfied are you with the complexity of the recycling process being reduced by the packaging material?

1 2 3 4 5

Not satisfied

Very satisfied

Reduced complexity of recycling process (importance)

*How important is reduced complexity in recycling process for your use?

1 2 3 4 5

Not important

Very important

LOGISTICS

Quantity and size

Correct amount and size (performance)

*How satisfied are you with the correct amount and size of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Correct amount and size (importance)

*How important is the correct amount and size for your use?

1 2 3 4 5

Not important

Very important

Volume and weight efficiency (performance)

*How satisfied are you with the volume and weight efficiency of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Volume and weight efficiency (importance)

*How important is the volume and weight efficiency for your use?

1 2 3 4 5

Not important

Very important

Packaging design

Innovation (performance)

*How satisfied are you with the innovation of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Innovation (importance)

*How important is the innovation for your use?

1 2 3 4 5

Not important

Very important

Handle ability (performance)

*How satisfied are you with the handle ability of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Handle ability (importance)

*How important is the handle ability for your use?

1 2 3 4 5

Not important

Very important

Stack ability (performance)

*How satisfied are you with the stack ability of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Stack ability (importance)

*How important is the stack ability for your use?

1 2 3 4 5

Not important

Very important

Logistical information

Flow information (performance)

*How satisfied are you with the flow information of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Flow information (importance)

*How important is the flow information for your use?

1 2 3 4 5

Not important

Very important

Transportation information (performance)

*How satisfied are you with the transportation information of packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Transportation information (importance)

*How important is the transportation information for your use?

1 2 3 4 5

Not important

Very important

Product protection

Physical protection against vibration/temperature/shock (performance)

*How satisfied are you with the physical protection by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Physical protection against vibration/temperature/shock (importance)

*How important is the physical protection for your use?

1 2 3 4 5

Not important

Very important

Barrier protection against oxygen/dust/water vapor (performance)

*How satisfied are you with the barrier protection by packaging?

1 2 3 4 5

Not satisfied

Very satisfied

Barrier protection against oxygen/dust/water vapor (importance)

*How important is barrier protection for your use?

1 2 3 4 5

Not important

Very important