Creating markets for recycled resources

Container Lite
Light-weight Glass Containers – The Route to Effective Waste Minimisation
FINAL REPORT

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Retailer Innovation Final Report

Exec Summary

This report details the findings of the WRAP funded Container Lite project. This project has been a partnership between Faraday Packaging Partnership and British Glass/Glass Technical Services (GTS) supported by major retailers, brand owners and the whole of the UK container glass manufacturing base. Its aim has been to reduce waste glass arising through the light-weighting of bottles and jars, through demonstrator projects to show how generic containers and even iconic brand shapes can be targeted and significant weight reductions made.

The project brought together market research from companies and independently focussed work from the Business School at Leeds University and British Glass, along with consumer perception research by Institute of Psychology (Leeds University) and technical evaluation of lightweight containers by independent test laboratories at GTS. Through this combination of angles, it is believed that the concept has been well tested and demonstrated.

With over 1.5 million tonnes of glass still ending in landfill in the UK, even a small percentage reduction would yield worthwhile reductions in waste being sent to landfill, and reducing the average container weight by 10% would yield 150,000 tonnes less waste……i.e. almost 50% of the current total WRAP target.

This project has demonstrated that in both high volume general stock container and major brand containers, there is this significant scope for weight reduction with minimal risk. The project has also demonstrated that even iconically shaped brands like Grolsch are valid candidates for the programme. Grolsch alone contributed 4,500 tones to the saving made in this demonstrator without affecting overall shape or style change.

Research was undertaken by the Institute of Psychological Sciences at University of Leeds to understand consumer's perceptions of glass both as a packaging material and of proposed lighter weight containers. This showed that consumers are less sensitive to weight changes than may be expected. Indications are that greater weight changes would be acceptable if the environmental benefits of the change were explained. The research underpinned identification of the appropriate approach to light-weighting.

From the outset it was understood that a key objective was to develop an approach to disseminating the project findings that would encourage maximum uptake of project findings. To this end, a survey of the UK Glass Container Market was completed by Leeds University Business School. This research identified the top selling branded containers across a range of food and drink categories (identified by UK sales quantity and current container weight) whose potential involvement in any future work would maximise the impact of weight reductions.

The project's primary target was to deliver weight savings of 7,400 tonnes during the project duration. This was achieved by working with a limited number of manufacturers and brand owners across a small range of food and drink containers including branded and stock. Containers for trial were chosen to represent a broad spectrum of product type and shape to demonstrate the technical issues involved. The secondary target was to work with glass manufacturers to gain a minimum of an additional 30,000 tonnes savings per annum within 12 months of the project's completion By the project end date of 31st March 2006, both the primary target and significant progress towards the secondary target were achieved, as demonstrated below.

Brand Owner (where applicable)	Manufacturer	Container	Tonnes Saved (during project)
Generic container	Allied Glass	70cl Spirits bottle	1,680
Generic container	Allied Glass	1.5L Spirits bottle	288
Heinz	Allied Glass	Lea & Perrins 150ml	744
Heinz	Allied Glass	Lea & Perrins 290ml	302
Coors	O-I (Owens – Illinois)	300ml Grolsch	4,500
Coors	O-I (Owens – Illinois)	300ml Fine Light	270
Seven Seas	Beatson Clark	Cod Liver Oil 170ml	27
Seven Seas	Beatson Clark	Cod Liver Oil 450ml	16
Generic container	Quinn	75cl Wine bottle	20,000
		Total	**27,827**

Although not initially envisaged, a packer-filler was involved in the work to 'close the supply loop'. Their presence has been instrumental in allowing exploration of generic food jars and spirit bottles, involving subtle ways to accommodate less weight, so allowing no disruption to filling lines and logistics.

Overall, the project has been a major success in bringing together the entire supply chain and allowing each party to learn of, and assist with overcoming of difficulties experienced in the process. The consortium of technology providers, manufacturers, packer-fillers, brands and retailers now forms a strong union with a strong momentum behind continuing to drive this process and extending significant new light-weighting across the whole of UK manufacture.

Whilst meeting the objectives developed at the start of the project, the project team have come to adopt the term right-weighting as a more appropriate description of the project goals as it takes into consideration production/filling and consumer related restraints.

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1 Introduction

This report details the results of work completed during the WRAP funded Container Lite project. The project's aim was to prove the principle from manufacturing and consumer perspectives that significantly reducing container weight either by re-design or light-weighting of an existing design can be achieved whilst not negatively affecting market share.

WRAP's target was to remove 310,000 tonnes of packaging waste from the household waste stream by March 2006. Container glass, used for wines and spirits, preserves and condiments, processed foodstuffs and baby food, constitutes over one million tonnes of domestic waste destined for landfill. As one of the heavier components of packaging waste, it was believed that a substantial contribution could be made to this target by reducing the weight of these containers, whilst preserving the containment capacity, integrity and functionality. In recent years, over 30% of weight has already been removed from some simple beverage containers. It was believed that current technologies would support similar savings for the wider range of glass containers. Light weight containers would also bring additional ecological benefits in the form of reduced energy requirements for manufacture and transport. Reduced costs would provide an important incentive for brand owners to adopt light weight containers.

Light-weighting is a process that many manufacturers undergo when making modifications to a container design. A key objective of the project was therefore to encourage a step-change in the approach to light-weighting and deliver weight reductions over the life of the project that might otherwise have taken years to achieve.

Whilst the project partners were encouraged to adopt "out of the box" thinking as an approach to redesign, it was acknowledged throughout the project that only following agreement from all interested stakeholders: manufacturer; customer (brand owner) and consumer would a lighter container be introduced to the market.

The project's main objectives were:

- To deliver waste savings, during the life of the project, through a number of full-scale production trials of new light-weighted containers
- To deliver further industry commitments, within the life of the project, to light-weighting of specified glass containers in specified quantities
- To develop a momentum within the industry with respect to the wider uptake of light-weighting driven by market possibilities, technical feasibility and consumer perceptions

2 Achievements

In addition to meeting the deliverables specified upon inception, the project achieved further successes. The achievements made can be summarised as:

- Primary target weight reduction of 7,827 tonnes
- Secondary target weight reduction of 20,000 tonnes
- Significant expansion of project consortium
- Demonstration of brand "safety net" via consumer perception studies
- Successful filling line trials

2.1 Primary target

The primary target was to deliver direct weight reductions totalling 7,400 from the production trials of a limited number of containers nominated by manufacturers and brand owners. The containers initially included comprised a range of food and drink containers from both branded and stock markets manufactured by Allied Glass, Beatson Clark and O-I (Owens-Illinois). The majority of nominated containers successfully met consumer, brand owner and technical requirements to proceed to full production at lighter weights. The tonnage savings achieved by these containers are shown in the table below. The table also demonstrates the savings to be made should the light-weighting principles proved during the project be rolled out to comparable products across the manufacturers production lines.

Manufacturer	Container	Brand Owner	Direct Savings (tonnes)	Savings if rolled out across generic production lines (where applicable)
Allied Glass	Lea & Perrins 150ml	Heinz	744	
	Lea & Perrins 290ml	Heinz	302	
	Generic Spirit 1.5 litre	Various (brand & own label)	288	
	Generic Spirit 70cl	Various (brand & own label)	1,680	8,591[1]
Beatson Clark	Cod liver oil 170ml	Seven Seas	27	
	Cod liver oil 450ml	Seven Seas	16	
O-I	Grolsch 300ml	Coors	4,500	
	Fine Lite 300ml	Coors	270	
Totals			**7,827**	

Table 2-1 Container Lite Primary Target

In two cases of containers identified as candidates at the start of the project, the light-weighted versions did not meet brand owner requirements and did not therefore proceed to production. This provided valuable learning to the project team in highlighting issues regarding brand sensitivity and the need to provide an adequate demonstration that light weighting will not affect market share.

2.2 Secondary target

The secondary target was to achieve commitment from the members of the project consortium to light-weight products within their current portfolio outside of the initial trials and through this to achieve a further weight saving of a minimum of 30,000 tonnes within 12 months of the project completion date. Significant progress has already been made towards achieving this target, as demonstrated below.

[1] Based on Allied Glass market share of 19.6% of 70cl whisky market

Manufacturer	Container	Brand Owner	Direct Savings (tonnes)
Quinn	Wine bottle 75cl	Various (brand & own label)	20,000
Total			**20,000**

Table 2-2 Container Lite Secondary Target

2.3 Expansion of project consortium

Industrial representation in the project consortium was initially comprised of three glass manufacturers (Allied Glass, Beatson Clark and O-I (formerly United Glass)) and three brand owners (Coors Brewers, Heinz and Britvic) who between them nominated the containers initially targeted. However, via a range of dissemination activities designed to promote the ongoing findings of the project, the project consortium was expanded to comprise of manufacturing representation (Allied Glass, Beatson Clark, O-I, Rockware and Quinn) and brand / retail representation (Coors Brewers, Heinz, Britvic, Co-op and Diageo). In addition, the core project team has presented the project to a number of other retail / brand owners who have indicted their interest in potential involvement in any future light-weighting project. These include Premier Foods, Wm Morrison, Tesco and Coca-Cola.

2.4 Demonstration of "safety net"

The value of brand identity cannot be underestimated and neither can a brand owner's understandable sensitivity to changing aspects of branded products. The light-weighting process developed during the project in which design and production trials were followed by comprehensive consumer perception studies (where deemed appropriate) and only following acceptable results from each of these stages was a light-weighted container taken forward to full production, demonstrated an appropriate "safety net" for manufacturers and brand owners alike.

2.5 Successful filling line trials

All filling lines are set up for specific container dimensions however, all also operate within a tolerance to accommodate variations in container size. When a container is light-weighted, even when retaining the same shape, minor changes to the overall shape are necessary to retain the volume required and this is likely to affect container dimensions. Where these changes to dimension fall within the filling line tolerance, the container can proceed down the supply chain without further issue. However, in some cases, the proposed container dimensions fell outside the tolerance, requiring further amendments to the design.

3 Project Structure

Container Lite was designed as a multi strand project calling on the expertise of a wide range of industrial and academic partners. The project structure agreed is demonstrated below.

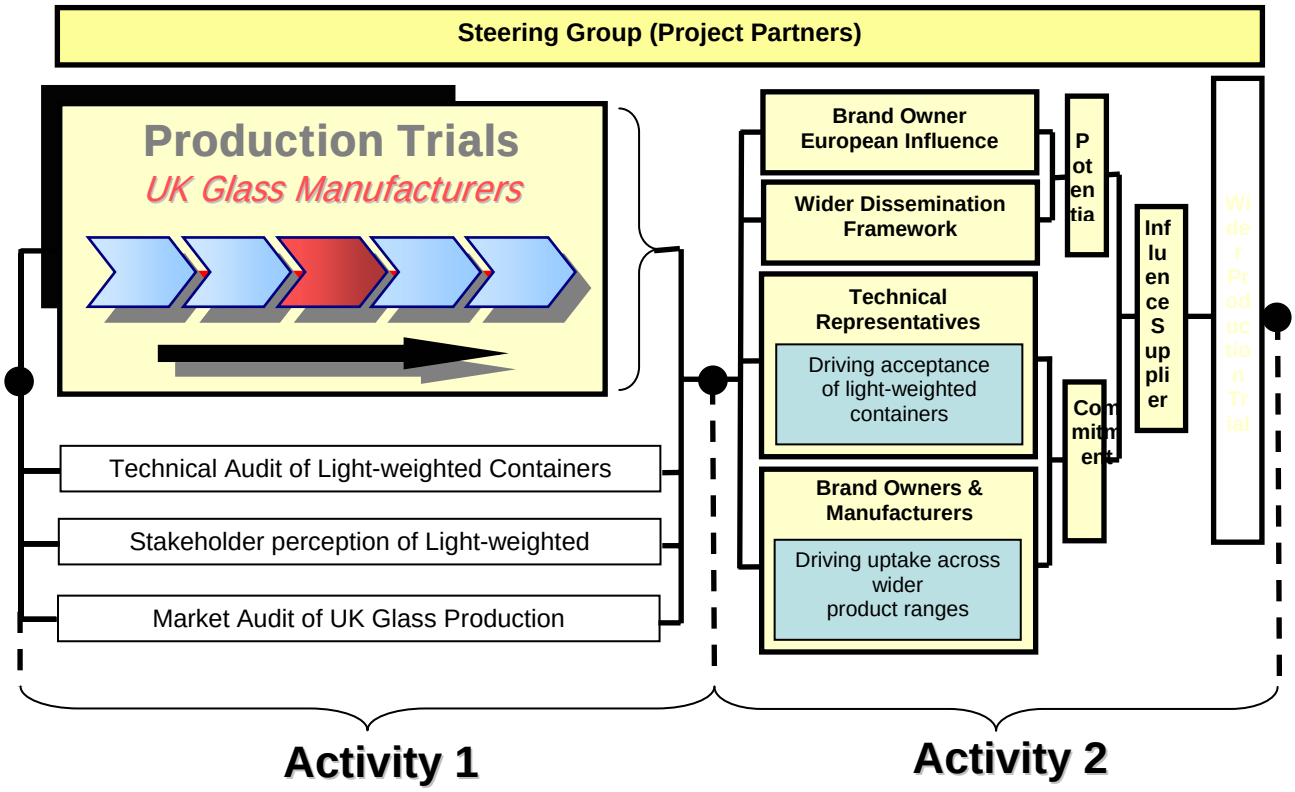


Figure 3-1: Project Structure

The four work streams undertaken in Activity 1 each contributed to an holistic understanding of light-weighting issues as relevant to manufacturers, brand owners and retailers. This understanding then directed the work undertaken during the Activity 2 phase as the dissemination activities were tailored to meet the needs of each of these stakeholder groups. Further details of the dissemination activities undertaken is provided in the remainder of this report.

3.1 Project Steering Group

All project partners both industrial and academic were considered integral to the development of the project and all had the opportunity to contribute to the project's direction via quarterly progress meetings. The quarterly meetings were open to all consortium members and each generally consisted of updates on the progress and significant results of each work stream. This allowed consortium members to keep abreast with developments across all work streams and contribute to shared learning through feedback of personal knowledge.

Dependant on the project outcome, the ultimate decision to proceed with light-weighting remains with industry (manufacturer, brand owner etc). To maintain this industrial focus throughout the project, it was considered appropriate to invite an industrial representative to chair the steering group. This function was undertaken by David Wiggins, Technical Director at Coors Brewers. The core project team would like to extend their thanks and appreciation to David for the commitment and advocacy he demonstrated to the project.

3.2 Project Partners

The project consortium was comprised of representatives from throughout the glass packaging supply chain. The consortium was made up of the following organisations:

Core Project Team	Research	Manufacturing	Retail / Brand
Glass Technology Services	Institute of Psychology, University of Leeds	Beatson Clark	Coors
British Glass	Leeds University Business School	Allied Glass	Britvic
Faraday Packaging Partnership		O-I	Heinz
WRAP (funding body)		Rockware	Co-op
		Quinn Glass	Phoenix Foods

Table 0-1: Container Lite Project Partners

Those identified in red were members of the consortium since the project's inception in February 2005. Those identified in black joined during the lifetime of the project. In addition, other key retail / brand companies have either committed to future involvement or expressed interest in becoming involved should the project be granted further funding. These include: Wm Morrison, Premier Foods, Diageo, Coca-Cola Europe, Edrington's, Grant's and Tesco.

The provision of regular steering group meetings provided opportunities for all consortium members to be updated on all activities. This was an effective strategy in encouraging additional involvement as less active consortium members were able to learn from project findings and use this knowledge to gain commitment within their organisation for more active involvement. The growth of the consortium during the project was part of a deliberate strategy of ongoing dissemination and again allowed for generic project findings to be absorbed, therefore encouraging more active involvement.

The core project team is immensely grateful to all members of the project consortium for their involvement in the project and commitment to project principles.

4 Consumer Perception Studies

This aspect of the report details work undertaken by the Psychology of Design group (PoD), within the Institute of Psychological Sciences, University of Leeds, as part of the Container Lite project. A summary of the methodology and key findings are provided here.

4.1 Project context / programme of work

Analysis of stakeholders' (brand owners, retailers, manufacturers, and consumers) perceptions of light-weighted glass containers was identified by several partner organisations at the inception of the project as being an essential project component. There was a concern that light-weighting of glass containers might adversely affect stakeholders' (and particularly consumer) reactions and consequently damage the market position of glass packaging. Such factors might include (but not be limited to) product type, consumer demographics, extent of light-weighting, and container design.

To address these concerns a programme of work was designed comprising of two main components:

1. Providing an overview of stakeholder perceptions of glass containers. This includes assessments of consumer perceptions of, and attitudes to glass in relation to competitor packaging materials and consideration of the effects of light-weighting in this context. This information was gathered through: i) a series of interviews with brand owners and manufacturers; ii) a series of focus groups with consumers (both male and female and selected to cover three age groups); iii) a profiling study, in which participants were asked to rate several different containers (glass and alternatives) with respect to a number of key descriptors; iv) psychophysics studies in which consumers' abilities to detect weight differences in packaging were investigated; and iv) a laboratory study of consumers perceptions of lighter and heavier bottles.

2. Providing support (in the form of focused data gathering) for project partners (brand owners and manufacturers) who were undertaking (or considering) light-weighting of glass containers. This component of the work comprised two studies. One comprehensive set of assessments was conducted for Coors, to assist in their deliberations relating to the light-weighting of beer bottles. The other study was a multi-component assessment for Unicheq Holdings, who wanted information on a possible approach to light-weighting a generic hot chocolate container. A summary of the report produced for Grolsch is provided in Appendix A.

The brief for this work was to examine consumer perceptions of, and attitudes to, on-shelf (in-store) presentation of products, but did not include testing in-use experiences.

4.2 Background Information

4.2.1 Light-weighting

A common concern of brand-owners and manufacturers is that light-weighting glass containers will serve to remove some of the advantages that glass is believed to have with respect to consumer perceptions of quality and sophistication. In Sections 3 and 4 of this report results of a series of interviews and focus group are presented that were designed to clarify/verify stakeholder perceptions of glass, and to establish more clearly views relating to light-weighting. These results provided a contextual frame of reference for subsequent assessments of light-weighting and support for light-weighting trials.

At the inaugural project meeting the complexities of some of these issues became more apparent. Many companies had begun a process of light-weighting glass containers (see Section 3). This had been achieved through a gradual process in which container shape had been maintained and weight reductions were sufficiently small for consumers not to notice them (see Section 5). It became apparent, at this time, that more substantial weight savings were likely to require changes in the shape of containers (to improve the structural integrity) and this presents potential problems with changes to brand image.

4.2.2 The CAPDeCO Assessment Framework

In all of the work conducted a set of components relating to consumer perceptions of packaging were used to guide data gathering. We argue that these components must be considered if a sufficiently 'broad' perspective of consumer perceptions and behaviours is to be obtained. These are based on existing literature relating to consumers' perceptions of different product designs (e.g., Bloch, 1995). They include:

- **C**ognitive associations and evaluations: People form cognitive associations between all sorts of things – people, places, things, feelings, even packaging designs. Understanding these associations can be informative when evaluating consumer perceptions (e.g. consumers might associate a design with a concept such as 'high class', or with being used in a particular setting, such as a party).
- **A**ffective responses: This component can perhaps be thought of as emotional reactions to designs. Although different product designs are very unlikely to evoke strong emotion, mild changes in, for example, pleasure or boredom might be reported.
- Perceptions of **p**racticality: Functionality and ease of use are very important considerations when evaluating different product designs. For example, how easy is it to open a particular packaging design.
- **De**sign descriptions: Generic descriptions of fundamental design characteristics. For example, is a design considered by consumers to be 'balanced' or 'logical'?
- **C**ontext: Product designs exist in a particular context and consumer perceptions may vary depending on this context. For example, a consumer may like a packaging design because it is unusual in that particular marketplace.
- **O**utcomes: Consumers' perceptions of, and attitudes towards, product designs will tend to influence behaviour or behavioural intentions. Behaviours are obviously important to brand owners and manufacturers. For example, it seems reasonable to assume that positive perceptions will increase the likelihood of sales. As part of our assessments of consumer perceptions we consider specific 'outcome factors' such as purchase intentions.

Although the approach to specific studies varied, these components provided useful 'touchstones', helping to make sure that all aspects of the problem were being considered.

4.3 Interviews with brand owners and glass manufacturers

4.3.1 Aims

These interviews were structured with three aims in mind. First, they were designed to provide an understanding of brand owners and manufacturers opinions about glass packaging, the potential for light-weighting, and the impact that this might have. A second aim of this work was to gather key adjectives that brand owners and manufacturers use: i) to describe glass; or ii) to describe brand values. These descriptors were used (where appropriate/possible) in subsequent quantitative studies conducted as part of this project by the PoD group. Finally, this component of the work was designed to form the basis of PoD support of light-weighting trials. They were an opportunity to provide industrial partners with more information about the research to be carried out by the Institute of Psychological Sciences, and to discuss the possibility for additional research, with a view to identifying specific research activities that could be targeted to support industrial light-weighting initiatives.

4.3.2 Methodology

Representatives from four Brand Owners were interviewed:

- Coors Brewers Ltd.
- Unicheq Holdings (Parent company of Phoenix Foods Ltd and Grand Foods Ltd)
- Britvic Soft Drinks Ltd.
- Heinz

Meetings also took place with representatives from two glass manufacturers:

- Allied Glass Containers
- United Glass Ltd. (O-I)

Due to project constraints beyond the control of the PoD group it was not possible to interview retailers at this time.

More than one representative of the industrial organisation was present at each meeting, with interviewees reflecting a range of relevant personnel roles, including Packaging Manufacturers, Development Directors, Packaging Developers, Glass Purchasers, Packaging Managers, and Marketers.

4.4 Summary of findings

All brand owners reported that they had adopted light weighting methods with some of their products ranging from 5-20% reductions. In such cases design alterations had focused upon height reductions. Such alterations were not deemed noticeable to the consumer, and on account of this, consumer testing was thought to be unnecessary. With regards to the promotion and recycling aspects of light weighted glass, brand owners stated that they probably would not advertise the light weighted glass but felt the Waste Resources Action Programme or British Glass would be the best organisations to promote such as measure.

The main benefit of light-weighting for brand owners was the cost reduction and savings that would result from light weighting. These savings were in three main areas: purchasing cost of materials; transportation costs; and reductions in packaging weight charges.

The following problems were perceived / foreseen with light-weighting:

- Weight reductions would increase container instability and the potential likelihood of breakages on the production line and during transportation.
- There was the belief consumers would view the lighter glass as breakable and fragile and that glass would loose its premium image that was associated with extra weight. This was coupled with a concern that consumers would be able to detect weight differences and would expect a drop in packaging prices as a result.
- Not all organisations felt that they used enough glass to benefit from the initial costs of moving to lightweight glass and some of the potential cost savings were considered insignificant. Some brand owners felt that cost benefits would only have short-term advantages if their rivals followed suit and also began to lightweight.
- Height and shape alteration were crucial issues with some brand owners reporting that drops in height could affect sales, particularly on products in which containers on supermarket shelves were all generic and where height reductions could be easily seen and compared by the consumer. The effects of shape alteration were important for the cost implications this would have on the glass moulding, filling and labelling equipment.
- Related to this, a key concern was the potential influence that container shape alterations might have on consumer perceptions of the brand, and particularly that iconic brand images would be lost.

4.5 Focus group study: Consumer perceptions of glass packaging and light-weighting

4.5.1 Aims

These focus groups were designed to provide insight into general consumer perceptions of glass packaging when compared to alternative packaging materials and, more specifically, the possible effects of light-weighting. Key topics addressed were similar to those covered in the brand owner/manufacturer interviews (described in Section 3). In each focus group, researchers gathered information from consumers about how glass compares to alternative packaging materials, what shoppers currently purchase and why, and what advantages and disadvantages they perceive for each type of packaging material. An important element of these focus groups was to pinpoint where glass faces most competition as a packaging material now and in the near future. This was approached by examining consumers' packaging material preferences, and the reasons for those preferences on a product by product basis. This information was intended to provide a foundation from which perceptions relating to light-weighting could be explored. Any changes to packaging weight, noticeable to shoppers, may have an effect on overall opinions of glass. An important goal of this research is to discover, if light-weighting is perceptible to consumers, for which products would this be regarded as acceptable, and which would meet with resistance. A further goal of the focus groups was to explore methods that could be used to promote the benefits of light-weighting glass and the recycling of glass. As with the brand owner interviews, adjectives were solicited from consumers that they might use to differentiate glass packaging from alternative materials and, more specifically, that might differentiate light-weight from 'normal' glass containers.

To explore differences that may exist between the consumers in terms of opinions or purchase decisions involving glass packaging focus groups were recruited to three different (adult) age groups. In addition, consideration was given to possible sex differences in consumer preferences/attitudes.

4.5.2 Methodology

4.5.2.1 Participants

To make comparison by age possible, participants were separated by age into three categories, a younger group, 18 – 33 years; a middle group 34 – 55 years; and an older group, 56 years and above. Each Focus Group contained participants from only one of the age groups and participants in each focus group were presented with the same products. In total 40 participants took part (18 males, 22 females, average age 44.6 years). They were recruited through advertisements placed in local newspapers, University websites and mail sent directly to staff. Each participant received £15 for the 90-minute session.

4.5.2.2 Procedure

All of the focus groups were conducted in the PoD Laboratory at the Institute of Psychological Sciences, University of Leeds. At the beginning of each session participants were given an overview of the nature of the session and asked to provide informed consent (as per B.P.S. ethical guidelines) including permission for video recording of the session. All focus groups were video recorded for later analysis.

4.5.3 Products Included in the Focus Groups

Stir In Sauces	Dolmio Stir in sauce (plastic container) Dolmio plastic sachet sauce (plastic container) Dolmio Bolognaise sauce 500g (glass bottle)
FAB	Smirnoff ice (glass bottle) Smirnoff ice (Aluminium/tin can) WKD (glass bottle) Reef (glass bottle)
Lager	Grolsch can (Aluminium/tin can) Grolsch bottle (glass bottle)
Table Sauces	Branston pickle (glass jar) Branston pickle (plastic bottle) Heinz Salad Cream (glass bottle) Heinz Salad Cream (plastic bottle) Heinz Tomato Sauce (glass bottle) Heinz Tomato Sauce (plastic bottle)
Conserves	Robinson's Raspberry jam (glass jar) Bonne Maman Strawberry Conserve (glass jar) Danish Reduced Sugar Marmalade (plastic container) Duerr's Fine Cut Half Sugar Fruit Spread (glass jar) Rose's Lemon & Lime Fine Cut Marmalade (glass jar)
Vegetables	Sweetcorn (glass jar) Sweetcorn (Aluminium/tin can)
Herbs	Morrison's Italian Style Seasoning (plastic container) Morrison's Italian Seasoning (glass jar)
Light-weighted products	Light-weighted wine bottles (Made by SG) Cotes de Rhone, Beaujolais Noveau and Muscadet Ultra Light-weighted spirit bottle (made by Allied Glass Containers)

Table 4-1: Products included in consumer perception testing focus groups

4.5.4 Summary

4.5.4.1 Opinions on glass as a packaging material

The focus groups helped to inform researchers at the Institute of Psychological Sciences of the reasons that consumers select glass products, and of factors that may affect purchase decisions to a greater extent than packaging material.

There were uniform rationalisations for selecting alternative materials over glass, most associated with practicality and specifically the ease with which glass can be broken.

On the whole there was a strong preference for glass in traditional glass markets, such as jams. Glass also has strong positive associations in contexts where consumers are in public settings. This should help to maintain the market share of glass as a packaging material in the near future. However, there were also some markets for which consumers were somewhat ambivalent about glass as a container material (e.g., value foodstuffs).

The gender of the consumer did not seem to have a strong influence on preference for glass or other materials. However some group differences in opinion were apparent when consumer age was considered. The older age group tended to feel more familiar with glass as a packaging format, and were more likely to view alternative materials as more expensive. The younger group of participants seemed quicker to accept new packaging formats and materials, but expressed a fondness for some iconic glass bottle designs.

4.5.4.2 Opinions of light-weighting of glass

Most consumers saw lightweight glass in a positive way, although there were some very clear and potentially problematic fears about the fragility and manner in which lightweight containers would break. Some consumers had questions as to how the glass would shatter and whether it would break into pieces like a car windscreen or shatter into thinner and more dangerous slivers. These concerns need to be addressed before any light-weighting process that is noticeable to consumers takes place.

Consumers often associated very light weight glass with plastic the first time they encountered it empty. Conversely, there were some expected associations between weight of glass container and quality, the heavier the better was the general conclusion. This was most apparent for premium goods, and not that strong for value products where packaging weight was not considered by the consumer on a conscious level to any great extent.

4.6 Psychophysics Studies of Consumer Sensitivity to Container Weight Differences

An important factor when considering the effects that light weighting is likely to have on consumers' perceptions of containers is the extent to which consumers are able to detect weight differences. From interviews with brand owners and manufacturers it was clear that some light-weighting has already been completed. Most of this was based on the premise that a certain degree of light-weighting is possible without the consumer being able to detect the difference. The scientific literature supports this position. There is a long history of psychophysics studies designed to identify the limits of human sensory perception (see e.g., Gescheider, 1997; Jones 1986). Weber and Fechner were pioneers in this field. In the 19th Century Weber proposed that a constant ratio exists between the intensity of an experienced stimulus (e.g., light) and the variation that would be required for a change to be noticed. For example, a person may be able to perceive the difference between lighting one versus two candles in a darkened room, but they may fail to detect the effects of lighting one more candle if 100 candles are already lit. More recent work has cast doubt on the accuracy of this position (Gescheider, 1997), particularly at extremes of stimulus intensity, such as very light weights (Engen, 1971). Nevertheless, for 100 years or so it was thought to be a good description, and it seems a sufficiently good approximation of human ability to detect changes in stimulus intensity for the purposes of this work.

On this basis, just noticeable differences in weight may be of the order of 2% of the stimulus intensity (i.e., a 2 gram change would be detectable for a 100 gram weight) (Sternberg, 2004). Therefore, in the current context, i.e., reduction of glass container weights, a reduction of 30g in a container weighing 300g (1%) would be unlikely to be detected. Moreover, it would follow that a specified absolute container weight reduction will be less likely to be noticed by the consumer if the container is full (i.e., when the total weight is greater). On the basis of a typical container/contents weight ratio, if a just noticeable difference of 2% is a reasonable approximation, it is thought that light-weighting of up to 5% might be expected to go undetected when the container is full.

However, the situation may be more complex than this. In the psychophysics literature a number of further influential variables have been identified. For example, differences in sensitivity have been linked to the effects of object surface texture. Flanagan et al. (1996) found that when participants were asked to detect weight differences between two objects of differing texture, they tended to report that the object with a smoother surface was heavier. Similarly, width of grasp has been found to be a factor in weight perception (Flanagan and Bandomir, 2000). Moreover, studies in this area tend to be conducted in laboratory conditions using rather artificial stimuli. It may be that results do not generalise to perceptions of consumer products in applied shopping contexts. For this reason, a multi-component investigation was conducted as part of the Container-Lite project to examine issues surrounding consumers' ability to detect weight differences in containers and their in-store behaviours that might relate to the detection of weight differences. In this

section we report two studies of ability to detect weight changes in wine bottles, mint jelly jars, a study related to instant coffee jars, and an in-store observational study of related consumer behaviour.

4.7 Wine Bottle and Mint Jelly Jar Study

This study involved two tasks related to the assessment of container weight: i) assessment of wine bottles; and, ii) assessment of mint jelly jars. To gain an understanding of the effect that different gripping and assessment methods can have on consumers' ability to detect weight differences, participants were assigned to one of three between subject conditions (assessment type) that determined the number of times that participants were allowed to pick up each container during each trial, and whether they were allowed to use both hands for comparison or only one.

4.7.1 Method

4.7.1.1 Participants

Thirty-six participants (16 females and 20 males) were recruited, via the Leeds University website and from the Leeds area via newspaper advertisements in the local gazette, to take part in the study. Participants ranged in age from 19 to 54 years (mean=29 years).

4.7.1.2 Materials

Sixteen Co-op own brand Mint Jelly Jars were utilised as stimuli for one task. Two of the jars were termed blanks (both weighed 406g) and were used as comparison products in every trial. The other 14 containers ranged in weight from 402g to 350 g (decreasing in one percent increments of the overall weight from the maximum weight). All the jars had the same Co-op Mint Jelly Label. Weight was added to the lightest container by inserting weights into the jelly and then resealing the jars. The weights were not visible from the outside and did not make a noise when the jar was moved around.

Ten Stowells Merlot red wine bottles (full) were used as stimuli for the other task. Two of the bottles were termed blanks (both weighed 1220g) and were used as comparison products in every trial. The other eight bottles varied in weight from 1232g to 1317g (1 percent increments in overall weight). Weight was added to shelf available bottles (1220g) by gluing weights to the bottom of the inside of each bottle. The red wine and corks were replaced once the weight had been added. All the bottles had the same labels attached.

4.7.2 Results

Analysis of performance on each task is structured here on a global, combined condition format initially followed by an in depth analysis of performance related to how the container was held and assessed. The most common way of assessing performance on tasks that utilize the adaptive one up one down procedure as used here is by averaging the levels at the direction reversals in the adaptive task (i.e. the turnaround points) (Leek, 2001). This method of threshold estimation has been used here. The only necessary assumption for use of this method is a monotonic relationship between stimulus levels and performance levels. There is no reason to suggest that this is not the case with performance on these tasks. The best possible performance on the task would be 1.5% difference.

4.7.2.1 Mint Jelly Task

Participants completed an average of 32 trials, ranging from 25 to 43 trials. The mean threshold for noting a difference on the task was 4.4 percent (SD = 2.04) (see Figure 5.1). Performance on the task ranged from a minimum of 1.5 percent to a maximum of 7.8 percent. Two participants had an average threshold of the minimum possible threshold, 1.5 percent.

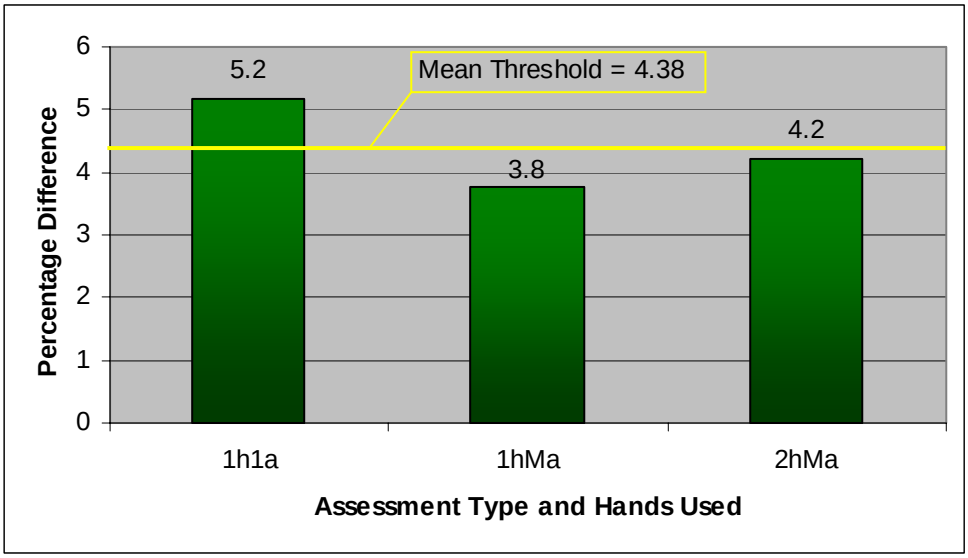


Figure 4-1: Threshold estimation values for mint jelly jars by assessment type and hands used (1h1a=1 hand and 1 assessment; 1hMa=1 hand and multiple assessments; 2hMa=2 hands and multiple assessments).

Participants in the two hands, multiple assessment condition performed slightly better than participants who were only allowed to touch the bottle with one hand, 4.2 percent compared to 4.5 percent respectively. Participants in the 'multiple assessment' conditions performed better on the task than participants in the single assessment condition. Average threshold estimations for the multiple assessment conditions were 4 percent difference compared to 5.2 percent in the single assessment condition. There was no reliable difference in scores for males and females. There was no reliable correlation between number of trials and performance for the mint jelly jar task (r = 0.218).

4.7.2.2 Wine Bottle Task

Participants completed an average of 28 trials ranging from 20 to 40 trials. The mean threshold for noting a difference for this task was 2.96 percent (SD = 1.101). Performance ranged from a minimum of 1.5 percent to a maximum of 6.8 percent. Two participants had an average threshold of the minimum possible threshold.

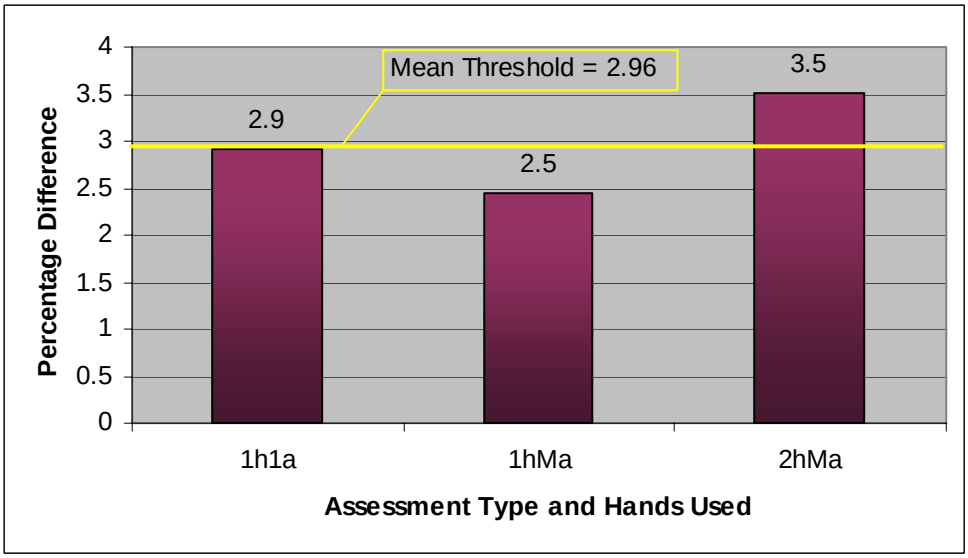


Figure 4-2 Threshold estimation values for wine bottles by assessment type and hands used (1h1a=1 hand and 1 assessment; 1hMa=1 hand and multiple assessments; 2hMa=2 hands and multiple assessments).

Performance on the task was superior in the one handed conditions compared to the two handed condition. Average performance in the one hand conditions was 2.7 percent difference compared to 3.5 percent difference when both hands

were used (see Figure 5.2). Average performance in the multiple assessment conditions compared to the single assessment condition was very similar. Participants in the single assessment condition had an average threshold estimation of 2.9 percent weight difference compared to 3 percent difference noted in the multiple assessment conditions. Differences were not significant. There was no reliable difference in the performance of men and women.

There was a significant correlation between number of trials and performance (r = 0.418, p=0.011). The greater the number of trials completed by a participant, the poorer the threshold estimate is likely to be.

4.7.3 Discussion

Performance on these two tasks suggests that in an applied context such as this, just noticeable differences (jnd) in weight may be slightly larger than identified in the previous literature (see e.g., Sternberg, 2004). Participants had an overall mean threshold of 2.96% in the wine bottle task and 4.38% in the mint jelly jar task.

Although participants performed slightly better on the wine bottle task than the mint jelly task when estimated thresholds for percentage difference are considered, when the percentage differences are translated into actual weights average performance on the mint jelly jar task was somewhat better than in the wine bottle task, 17.5 g compared to 36g.

Differences in participants' sensitivity to weight differences resulting from the manipulation of assessment method (number of hands and number of assessments) these were not sufficient to be considered reliable.

There was a correlation between the number of trials completed by a participant and their task performance on the wine bottle task. As the number of trials increased, estimated threshold levels were also seen to increase. This may indicate a changing threshold for some participants due to fatigue. The one up one down adaptive procedure is regarded as the quickest and most efficient method of understanding jnd thresholds as it does not require participants to complete any more trials than necessary.

4.8 Coffee Jar Study

When participants are asked to make repeated comparisons of weights there is the possibility that performance will be influenced by effects of training or, as discussed with respect to the wine bottles, fatigue. Repeated assessments would not typically be part of in-store buying behaviour (see observational study reported below). Therefore, a further study was conducted in which a larger sample was tested, with each participant being asked to make only a single weight comparison.

4.8.1 Method

4.8.1.1 Participants

One hundred and twenty five participants from the University of Leeds were approached around the campus and presented with two full instant coffee containers.

4.8.1.2 Materials

Six coffee containers were used in the study. These were identical in appearance but differed in total container weight. One container was the original unaltered weight, whilst the others had been manipulated and had weight added. The product weighed 100g, and the original jar weighed 267g. The added weights increased the container weight by 5, 10, 15, 20 and 25 percent and the total (full) container weight by 3.64, 7.28, 10.92, 14.56, and 18.2 percent. It should be noted that the product/container weight ratio for this coffee container is relatively small compared to many other products.

4.8.1.3 Procedure

Participants were approached on an opportunity sampling basis and asked if they would like to take part in a study. If they agreed they were then asked to hold two coffee jars and state which container they believed was the heaviest. Pairs of containers included the unaltered container and one of the other five weights (in equal numbers, n=25, per weight).

4.8.2 Results

Figure 5.3 shows the percentage of participants who incorrectly responded when asked to detect the various weight differences between the original jar and a jar that had added weight. (It is important to note that, in a forced choice task such as this, 50% would indicate insensitivity.) Overall results indicate a linear trend with participants becoming less able to judge accurately which jar was the heaviest as the weight difference became progressively less. In this instance a container weight difference of 5% equates to a total package weight difference of 3.64%. Therefore, it would appear that at approximately this ratio participants were relatively unable to make an accurate judgment (the percentage of incorrect judgments approached 50%). Conversely, with a container weight difference of 20%, which equates to a total container weight difference of 14.55%, most participants were accurately able to distinguish the lighter from the heavier container.

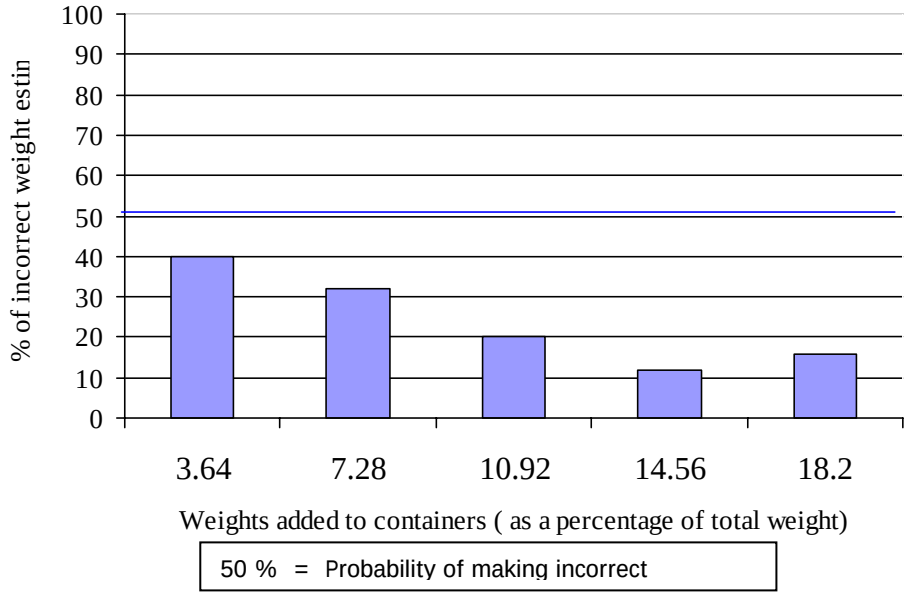


Figure 4-3: Percentage of incorrect estimations of weights of coffee jar containers (when compared with original)

4.8.3 Discussion

The results of this study suggest that in a context that provides greater environmental distraction and only one opportunity for weight assessment (such as might be encountered in a supermarket), and when judging relevant stimuli (i.e., packaging), ability to detect weight differences may be slightly poorer than predicted. Given that 50% correct assessments would be anticipated if performance was completely random, 75% may be taken to reflect sensitivity in 50% of participants. In this case, weight differences in the region of 8-10% were required to obtain this outcome.

4.9 An In-Store Observational Study

It seems that weight assessment may be poorer when there is limited opportunity for assessment. Moreover, perhaps depending on product type, consumers may not pick up products other than those purchased (thereby reducing chances of noticing weight differences). Previous studies of in-store behaviour suggest that consideration and selection of a product (from an on-shelf array) is completed very quickly. The average time in a supermarket aisle, before a selection was made was only 13 seconds for detergents (Hoyer, 1984) and 9 seconds for shampoos (Leong, 1993).

In order to examine consumers' opportunity for assessing container weight, an in-store observational study was conducted. Observations were recorded of the number of products that each consumer picked off the shelf before making a selection, the number of times two products were held simultaneously, and the total number of products selected. This was done for four different product categories: i) wines; ii) jams; iii) coffee; and, iv) cook-in-sauces.

4.9.1 Method

Participants: A total of 85 consumers (27 male, 58 female) were observed making purchase decisions in 8 different supermarkets (Four Morrison's stores, two ASDA stores, one Sainsbury's store and a Tesco store). The average estimated shopper age was 42 years. Four different food and drink categories of wines and spirits, jams and spreads, stir in/cook-in sauces and coffee were observed. 30 shoppers were observed for wine and spirits, 14 for jams and spreads, 18 for coffee and 23 for stir in sauces.

4.9.1.1 Procedure

Participants were observed choosing and selecting glass products as they shopped by two observers posing as shoppers. Actual age assessments were not possible due to the observational nature of the study, so estimates were made. Observations were opportunistic and were of novel customers and instances only. If a customer returned to the shelf, the data was not included in the final analysis. Furthermore, observations were discarded if the consumer failed to select a product from the category, and moved away from the shelf.

4.9.2 Discussion

Results indicate that consumers tended not to pick up more than one container at a time (which would allow two handed weight comparison) This could be due to the nature of the shopping environment in that one hand was often used to select products whilst the other pushed a trolley or held a basket. Hand switching was uncommon, only occurring in a small number of observations. Further, shoppers tended to only pick up containers that they selected for purchase, thereby not allowing one handed weight comparison. The number of occasions on which a container was picked up and then not selected was relatively small. Some category variation was apparent, but this pattern was relatively consistent. The number of products selected varied between categories, with more products being selected by individual consumers for wine. This may conceivably provide an opportunity for weight comparison. However, the consistent ratio with number of products selected suggest that it was not influencing purchase decisions. Generally, these observations imply that shoppers do not have many opportunities for direct weight comparison. Of course this does not preclude reference with remembered product weights from prior experiences. However, it would suggest that opportunities to detect light weighting are limited.

4.9.3 Conclusions

Results from these studies suggest that consumers' sensitivity to weight differences in this applied context may be slightly worse than anticipated on the basis of previous literature. In a laboratory setting ability to detect differences ranged from 2.5% to 5.2% of full container weight. However, these estimates were based on a series of trials. When participants were given only one opportunity to detect a weight difference, as would be more consistent with in-store behaviour (see below), a 3.64% total weight difference was relatively unnoticed and 8-10% weight differences were associated with approximately 50% of participants making an accurate detection. As mentioned in the introduction to this section, the notion of a fixed ratio between stimulus intensity and stimulus change must be treated as an approximation and, of course, the criterion against which sensitivity is judged, i.e., the proportion of participants making successful detection, is somewhat arbitrary, and a more stringent criterion may be considered appropriate in this context. Nevertheless, these results provide some indication of likely sensitivity to 'cued' weight differences, i.e., when the participant is aware that there may be a weight difference to be found.

Of course, this is not fully representative of the in-store experience of shoppers, in that they would not typically be focusing on weight differences. This view is supported by the observational study that was conducted and reported above. Shoppers were observed selecting four different types of products: wines, jams, coffee, and cook in sauces. Generally, shoppers were seen to pick up only those products that they selected for purchase. This would suggest that the likelihood of weight differences being detected is smaller than might be assessed on the basis of psychophysical evidence alone. Moreover, if participants were not expecting a weight difference, this estimate might be revised downwards still further. The study reported in Section 7 begins to address this issue.

4.10 A Comparison of Consumer Perceptions of Glass and Alternative Packaging Materials

The interviews and focus groups (reported in Sections 3 and 4) provided qualitative evidence of differences in perceptions of, and attitudes to, glass and alternative food and drink containers. The laboratory study reported in this section of the report was designed to pursue these issues in more detail and to provide quantitative comparisons. Also of interest was the extent to which perceptions may vary according to the product under consideration. The intention was to provide the beginnings of a 'baseline profile' for a range of products, against which the effects of light-weighting might be judged. It was also important to establish the extent to which consumers perceptions of ands attitudes to glass containers are product dependent. Consequently, for this study, two drink (beer and FAB) and two food (tomato ketchup and vinegar) products were selected for testing. Participants completed a comprehensive questionnaire assessment for each product when contained in glass and when contained in a familiar alternative (e.g., a can). The questionnaire used was developed in combination with the Colourite project. Item selection was based on the CAPDeCO model described in Section 2, with items also included if they had been identified as important from the focus groups or interviews with brand owners and glass manufacturers. As a preliminary step, the results from participants questionnaire ratings from this study and one of the studies completed for the Colourite project were subjected to factor analysis, and scales identified on the basis of replication across the two sets of data. There scales were: decorative, logical, fun, pure, traditional, everyday, fragile, practical (logistics), quality, positive affect, and negative affect. In addition, some single items relating to behavioural outcomes (e.g., "I would like to purchase products in this container….") were retained. A more detailed account of the process of questionnaire development is in preparation and it is hoped that this will be made available in the form of an academic journal paper (Westerman, Tuck, and Oates, *in preparation*).

4.10.1 Method

4.10.1.1 Participants

Forty-eight participants were recruited through posters placed around the University of Leeds, in a local Age Concern centre, and around the city centre, and also through advertisements in a local newspaper. Equal numbers of men and women were assigned to three different age groups, as follows (each with 16 participants): 18-34; 35-55; and 55+.

4.10.1.2 Materials

Four sets of food and drink products, each contained in both a glass and an alternative material were used (eight in total). These were: Grolsch lager in a 300ml bottle and 440ml aluminium can; Smirnoff Ice vodka mixed drink in a 275ml glass bottle and 300ml can; Heinz Tomato Ketchup in a 300ml glass bottle and 400ml plastic bottle; and, Sarsons original malt vinegar in a 250ml glass bottle and 300ml plastic bottle (see Figure 6.1).

a) Heinz tomato ketchup containers

b) FAB: Smirnoff Ice bottle and can

c) Grolsh beer bottle and can d) Sarson's vinegar containers

Figure 4-4: Containers tested: a) tomato ketchup; b) FAB; c) beer; and , d) vinegar.

4.10.2 Procedure

Products were presented individually, approximately 60cm from the participant, and in a counterbalanced sequence. There were no restrictions with regards to holding and picking up the products. Lighting levels were set to approximate supermarket conditions. The sequence of presentation was manipulated so that participants never saw the same product (in different materials, in immediate succession. This was done to reduce the possibility that participants would predict the purpose of the study and to discourage direct glass/alternative comparisons. Participants completed the 59 item questionnaire for the product in front of them. This process was repeated for each of the eight product/container combinations.

4.10.3 Discussion

Consistent with qualitative information gathered from the interviews and focus groups (see Sections 3 and 4), there was an advantage for glass containers over those made from alternative materials with respect to consumers' ratings on the scale reflecting cognitive evaluations of 'quality'. Although mean ratings for glass were higher for all product types tested, this effect was stronger for some products than for others, with the difference between glass and alternatives being greatest for beer and smallest for tomato ketchup. A similar pattern was also apparent for the 'decorative' design descriptions scale. If decorative design characteristics are important determinants of quality perception in glass, and if light weighting of glass reduces perceptions of quality, as has been hypothesised, this would present some difficulties, given that many features associated with decorative glass container designs (e.g., curvy, colourful) are achieved at the expense of weight (see also case study report for Coors). However, the overall (averaged across all products) association between the 'decorative' and the 'quality' scale was only moderate (r=0.44), and neither of these scales was consistently predictive of a preference for glass over containers made from alternative materials (quality only contributed to the prediction of material preferences for the FAB container). It would seem that preference for glass is more complex and results from a complex combination of factors.

This is consistent with the finding of no overall difference in purchase preference for glass versus alternative materials. Results point to a number of different patterns of consumer responses. It may be that purchase preference results from a complex combination of factors combined with the effects of individual differences (see Section 7 for related evidence). If participants' ratings on a single item measure of purchase preference was the only measure used to assess differences between containers, many potentially important distinguishing features relating to consumers' perceptions and attitudes would be missed. Consistent with this, it is important to note that the patterns of means varies, across container and product types, for the different scales. This supports the use of a multi-component assessment approach. If all the patterns were the same there would be little point in making so many assessments. Several of these differences were consistent with patterns identified qualitatively in the focus groups and interviews. For example, glass was rated as being more 'traditional' and less 'everyday' than the containers made from alternative materials. However, of particular interest are interactions with product type. For example, advantages for glass are apparent on a number of scales when considering Grolsch beer. This is particularly the case for ratings of 'quality', 'fun', and 'decorative'. A preference for the Grolsh bottle may also be subject to sex differences with older participants and women tending to prefer glass (as indicated by ratings for 'like to purchase', and affect, respectively). In contrast, the pattern of means for tomato ketchup was quite different. A key feature of the glass container for this product seems to be consumers' perceptions of it being 'traditional'.

There was a consistent advantage for glass with respect to participants' assessments of how appetising the contents appeared. The importance of this scale in identifying differences in consumers' responses to glass containers of different colour has been reported elsewhere (see Colourite project final report). The findings here support this position. However, it is possible that the results are somewhat artefactual, given that for some of the alternative material containers it was not possible to see the product. Nevertheless, it is possible that such effects extend beyond those of simple product appearance. In the focus groups, reported above, there was reference to products tasting better when consumed from glass and having a metallic taste when consumed from a can. It may be that there are taste associations related to glass as a packaging material. Although conclusions relating to product taste that can be drawn from this study are limited, this issue is worth further examination.

To determine features that may be particularly important in determining consumers preferences for a particular container material, a series of regression equations were calculated in which difference scores (glass – alternative) were used. This was done for each product separately and also as a total. The dependent variable in each instance was differences on the item 'I would like to purchase' and predictors were differences in the CAPDeCO scales. From these, it would seem that changes in perceptions of 'fun' may alter purchase preference for Grolsch and Heinz tomato ketchup. In contrast, light weighting associated changes to ratings for the 'pure' or 'quality' scales would be more damaging for the Smirnoff FAB, and changes to the 'pure', 'negative affect', and 'logical design' scales may be damaging for preference for Sarson's vinegar in glass. When all products were considered together, 'positive affect' and 'pure' appeared to be the important scales. From this, it would seem that efforts towards light-weighting should be considered on a case-by case (product by product) basis, as the impact may be idiosyncratic.

4.11 Consumer Perceptions of Spirit Bottles that Differ in Weight

This study was designed to provide a quantitative assessment of the potential association between glass weight and consumers' perceptions of and attitudes to glass containers. In focus groups and interviews, the concept of quality was identified as potentially important in this context, with heavier glass being associated with higher quality. Results from the 'baseline profiling' study, presented in the previous section, suggest that a broader range of constructs may be important when considering consumers' reasons for buying products in glass containers, and that these may be product dependent.

In the study reported in this section, these associations were quantitatively assessed. A vodka bottle was selected for testing, on the bases that: i) this is perceived to be a relatively high quality product; ii) this is a product type with potential for substantial saving from light weighting; and, iii) different weight samples were available that were considered to be reasonably similar in other respects. To examine the effects of container weight convincingly, it is necessary to have different levels of this variable (i.e., lighter and heavier containers) while all other variables remain constant. This is not easily achieved, as substantial changes in container weight are generally accompanied by changes in container shape. It was necessary to have sufficient weight differences between the containers that, at least some, consumers would be able to detect its existence. Pilot testing was undertaken to establish this. The danger, if the containers are not identical in shape, is that there is uncertainty as to whether any differences in consumers' responses to the containers are due to weight or to shape. It was felt that, in this instance, although the match between bottles was not perfect (see Figure 7.1), it was sufficiently close to be worth proceeding. In fact, although there are disadvantages, it is believed there may also have been advantages associated with having non-identical containers with respect to shape. This issue is discussed below. Nevertheless, some caution must be exercised when interpreting results of this study.

As a secondary goal, this study examined consumers' sensitivity to explicit differences when they were 'un-cued' (i.e., when they were not aware that they existed). From the psychophysics studies, reported above, it is apparent that small container weight differences are likely to go unnoticed by the consumer. However, for these tests participants were aware that there was potentially a weight difference between the products being compared. Consequently, results may provide an unduly pessimistic (from the perspective of light-weighting) assessment of consumers' sensitivity to weight in 'real world' in-store situations. This is supported by the results of the observational study, also reported in the previous section, in which consumers' behaviour was such that opportunities for direct product weight comparisons were few (for many product types, instances when more than one product was picked from the shelf were relatively rare).

4.11.1 Methodology

4.11.1.1 Participants

Thirty-two participants, 16 males and 16 females aged between 18-53 years (mean=31.8 years) were recruited via advertisements on the University of Leeds website and promotional posters distributed around the university campus. In order to take part all had to be vodka drinkers, who had purchased a bottle in the last year. Participants were recruited

to two age groups of 18-29 years and 30+ years. This split was determined on the basis of data obtained from a Mintel report analysing the white spirits sector (Mintel International Group Ltd, March 2005 White Spirits UK), which indicated the majority of vodka drinkers were aged between 18 and 24 years.

Of the 32 respondents 50% stated Smirnoff was the best vodka brand they could think of, followed by Absolut vodka (22%). The remaining 8% stated a variety of other brands. In terms of factors that influenced purchase intentions, taste of the vodka scored highly at 53%, followed by brand name (28%), price (16%) and colour (3%). With regards to form of transport used when shopping, 48% walked, 33% used a car, 10% got a taxi, 6% a bus and 3% cycled. Employment status was as follows; 63% were students, 31.3% were Employed, 3% Retired and 3% Unemployed.

4.11.2 Materials

4.11.2.1 Containers

A heavy (approx. 500 grams) and a light (approx 300 grams) bottle were used for testing (305 and 312 gram bottles were used for the 'light' condition, presented in a counterbalanced sequence). The heavier and lighter bottles were selected because they were similar (although not identical) in shape (see Figure 7.1). Both were filled with 70cl of pure vodka and this quantity was marked on the label.

Two fictitious brand labels *Braveltz* and *Mitszch* were designed to be appropriate to the product. Designs were based on currents brands in the market place. Label height was approximately 14cm. The Braveltz design was placed vertically on the bottle whilst the Mitszch design was placed horizontally across the bottle.

Figure 4-5: The 'heavy' (left) and the 'light' bottles with the 'Braveltz' (left) and 'Mitszch' (right) labels.

4.11.3 Procedure

Participants were presented with the two vodka bottles/designs, displayed on a white shelf, with the product labelling facing to the front (as they would appear on a supermarket shelf). Lighting levels were set to approximate those experienced in supermarkets (500-700 lux). Participants were asked to give their views on each of the vodka bottles/designs. They were informed that this was part of a process of assessing the designs for marketing purposes. They were not informed that the bottles differed in weight. Initially participants were asked to pick up each bottle individually for 20 seconds. They were then asked to pick up the bottle on the left for 10 seconds. Order of assessment (heavy or light bottle on the left and therefore first to be assessed) and label (Braveltz or Mitszch label on the heavy bottle) were counterbalanced. Participants then rated this bottle using the CAPDeCO questionnaire. After every 20 questions participants were asked to put the bottle down and take a break for 10 seconds to avoid fatigue. When the first questionnaire was completed the pattern was repeated for the other bottle. Finally, participants completed the second, 19 item, questionnaire.

4.11.4 Results

By counterbalancing the presentation of labels across bottle weights (some participants saw Braveletz on the heavy bottle and some saw this bottle with the Mitszch label), once effects of labels have been averaged, remaining differences in participants' perceptions of the bottles should relate to weight (or possibly shape).

The manipulation of bottle weight had no effect on participants' preference selection, with 16 participants selecting the heavier bottle and 16 selecting the lighter bottle as being preferred. When asked to identify differences between the bottles, twenty-three participants reported shape differences without being given 'shape' as a prompt. Of those participants (total = 14) that noticed the weight difference between the bottles, five preferred the lighter bottle and nine preferred the heavier bottle. Of those preferring the lighter bottle reasons for their choice included perceived smaller size, this being easier to hold and to transport (2 participants). This was mentioned in relation to taking the bottle to a party, when transportation is more important than quantity. Of the participants who noticed the weight difference and preferred the heavier bottle, the shape was cited as a reason for preference, particularly at the bottom of the bottle, the weight was given as a reason by two participants, one suggesting that this would make it less likely to break. Perceptions of being more expensive, having greater quality and elegance, and of being more 'up market' were also given as reasons for selecting the heavier bottle (5 participants).

When asked "Would it matter to you if vodka was produced/sold in a lighter glass bottle?", 17 participants said 'yes'. Of those that said 'yes', nine saw advantages for the lighter bottle relating to ease of transportation and eight saw advantages for the heavier bottle relating predominantly to perceptions of quality (including associations with the quality of the contents). One participant also mentioned reduced fragility as being advantage of glass weight.

Nine participants (out of 32) thought that they would notice the difference in weight if the products were on a supermarket shelf. Of these, seven said that it would discourage them from buying the product. These all seem to prefer the heavier bottle, with one exception that seemed to prefer the lighter bottle because of ease of transportation. In addition, five further participants said that their choice would be altered if they noticed the weight. Three of these preferred a lighter bottle for reasons of transportation and two preferred a heavier bottle due to perceptions of quality.

When asked directly whether a lighter weight bottle would change their view of the quality of the product, 12 participants said that it would, with six of these saying that they would think the quality to be lower, three saying that they would think the quality was higher, and three not indicating a direction. When asked whether they thought manufacturers should inform consumers of light weighting of bottles and promote the benefits all participants said they would be in favour of this.

4.11.5 Discussion

There was a direct effect of bottle weight on participants' ratings on the 'practicality' and 'fragility' scales. These were consistent with participants' un-prompted reports on the final questionnaire, with the heavier bottle being assessed as more practical (this scale related to ease of transportation, storage, and holding the container) and as being less fragile. These results help to validate these questionnaire scales. They also indicate that there may be both advantages and disadvantages associated with light weighting. Moreover, results from the final questionnaire suggest that consumers may vary with respect to the importance attached to these different aspects. Some consumers focused on the issue of practicality, and for them this would have been influential when making a purchase decision. Others were more strongly influenced (in the opposite direction) by the issue of fragility.

When considering the responses only of those participants that noticed the difference in weight, further differences in perceptions of, and attitudes to the containers were apparent. These participants regarded the heavier container as being higher in quality, as eliciting greater positive affect, as having more appetising contents, and as being more 'pure'. Generally, it would seem that, when the weight difference was noticed, this was accompanied by additional assessments of container characteristics, and that on these dimensions the heavier bottle was viewed more favourably.

Of course, as set out in the introduction to this section, effects of container shape cannot be discounted when assessing participants' responses to the different bottles. However, running counter to a 'shape' explanation, as described here, many effects of weight were only apparent in those participants who detected the weight difference (this is not exactly the same set of participants that reported shape differences). As a further limitation, it should also be noted that only one product type has been tested in this study. As demonstrated by the 'baseline profiling' study, reported in the previous section, consumers views of glass and alternative material containers may vary as a function of product type. Therefore, effects of light weighting may also be product dependent. Further tests are required to establish this.

It is interesting to note that relatively few participants (14 out of 32) noticed the weight differences, even though the magnitude of these differences, when considering full bottle weight, was in the region of 20%. These findings extend those of the psychophysics and observational studies reported in Section 5. It would seem that, in somewhat applied and 'un-cued' contexts (i.e., participants are not informed of weight differences) relatively substantial weight differences may go unnoticed. In this respect, slight variations in bottle shape may have been advantageous for the interpretation of results. If the bottles had been absolutely identical in shape, participants failing to detect weight differences may have been due to their thinking that the only design manipulation that had been made was to the bottle label. This is a potential difficulty with this type of experimental design. It relies on a degree of 'misdirection' of participants to produce 'un-cued' responses. Of course, participants' responses are then dependent, to some degree, on the extent of the

misdirection. In this instance, it is argued that many participants were aware that there were differences in bottle manufacture and so would have been 'open to' the possibility of weight differences.

The experimenter did not verbally inform participants that the bottles contained equal quantities of vodka. However, the volume contained in the bottle was marked on the label. Nevertheless, some participants felt that the lighter bottle contained less (possibly based on assessments of shape and height). This may be an issue for consideration when redesigning for lighter weight. Further implications of these findings, with respect to industry approaches to light weighting, are considered in the following section.

4.12 Conclusions

In this section of the report we summarise findings for this project Work-stream and draw conclusions. The work completed by the Psychology of Design group for the Container Lite project included: i) interviews with brand owners and glass manufacturers; ii) focus groups with consumers; iii) psychophysics studies of consumers' ability to detect weight differences; iv) an observational study of in-store behaviour; v) a laboratory study comparing consumers' perceptions of, and attitudes to, containers made from glass and other materials; and, vi) a laboratory study of consumers 'un-cued' ability to detect weight differences in glass containers and the effect that 'un-cued' weight differences have on perceptions of and attitudes to the product. In addition to this, two multi-component case studies were undertaken, one for Coors Brewers and one for Unicheq Holdings. These were conducted as part of the process of supporting the evaluation of light weighting possibilities.

4.12.1 General perceptions of glass

It would seem that brand owners and manufacturers view glass generically as a premium container material. One of the main reasons for selecting glass as a packaging material has been to take advantage of perceived consumer associations between this quality and the contained product. However, the results of the focus groups (see Section 4) and the 'baseline profiling' study (see Section 6) suggest that such associations may be determined, in part, by product type. In the focus groups, associations with quality seemed to be stronger for alcoholic beverages and high value products, and were not apparent for some 'economy' food products. When considering foodstuffs, more unusual, and often branded, plastic or foil designs were sometimes expected to be more expensive by participants. Similarly, in the 'baseline profiling' study, glass was rated consistently higher on the 'quality' scale than containers made of alternative materials, but differences between glass and alternative material containers were greatest for beer. When quality was considered as a potential determinant of purchase choice (glass versus alternative) this only accounted for unique variance in the case of the FAB, for which a preference to purchase glass was associated with greater perception of quality for glass (see Section 6).

When considering affective responses, consumers participating in the focus groups reported often finding pleasure in glass packaged products. Sometimes this related to a liking for traditional shapes they had seen for years or for particular iconic designs (e.g., the Coca Cola and Grolsh bottles), but the thicker, angular and embossed elements to glass packaging were also mentioned in this context. Detailing and embossing on the glass container seemed to be important contributors to consumers' perceptions of higher quality and the enjoyment they derived from the packaging. Tactile properties of containers (e.g., embossing) were mentioned in this regard, although their value may be somewhat dependent on the context of use. Similarly, in the 'baseline profiling' study, glass was rated higher than alternative packaging materials on the 'decorative' scale. However, differences in ratings for the 'positive affect' scale tended to be product specific. An interaction between material type and container type suggested that some glass products (e.g., the Grolsh bottle) produced higher positive affect than the alternative material container, whereas for other products (e.g., Heinz tomato ketchup) the alternative container was associated with a more favourable emotional response. Generally, the pattern of results supports the contention that it is valuable to consider 'positive affect' in addition to cognitive evaluations of quality. 'Fun' also seemed to be an important construct, in this regard. Differences, again, appeared to be product specific. However, associations with 'fun' helped to predict preferences for purchasing some glass containers (Heinz tomato ketchup and Grolsh beer) as opposed to containers made from alternative materials.

In the focus groups, glass was viewed as a traditional material. This was particularly so for older consumers who, perhaps for this reason, seemed to have less strong associations between glass and high quality products. Tradition, in this context, was generally viewed as a positive cognitive association, relating also to familiarity in context of use, another construct that led to positive consumer responses to packaging. This picture is broadly consistent with results from the 'baseline profiling' study, although overall differences on the 'traditional' scale between glass and containers made from alternative materials seemed to arise from certain product specific differences (particularly for Heinz tomato ketchup). The positive view of glass, put forward in the focus groups, also supports the psychometric distinction between the 'traditional' and the 'everyday' scales used in the CAPDeCO questionnaire assessments.

In the focus groups, fragility was a major disadvantage noted for glass containers. The importance of this negative attribute varied a little depending on the context in which the container would be used. For this reason glass was not the packaging material of choice for consumers if the container would be used at certain outdoor events (barbecues, parties) or would be used by children. However, baby-food was an exception to this. Perhaps this is because, in this context, the container would be used by the mother, perhaps because the 'traditional' associations of glass are important, but probably also because of purity requirements. Differences in consumer perceptions of fragility were also found when comparing glass to containers made from alternative materials in the 'baseline profiling' study. In focus groups glass tended to be associated with more expensive venues, such as restaurants and bars and more formal occasions. Alternative materials were associated with less expensive events, such as parties and barbecues. In part this was due to practicality reasons, as mentioned above. Some consumers stated that they strongly associated plastic packaging with eating outdoors. A common statement from consumers was that they would be happier putting glass jars on the dinner table, as opposed to plastic. Individual differences in the value placed on certain attributes and the context of use were noted in the study of vodka bottles reported in Section 7. Some participants valued light weight and a perceived (rather than actual) smaller quantity contained because they wanted to take the bottle to parties and felt it was easier to transport and offered a more appropriate volume.

An important practical advantage for glass over competitor materials that was noted by the consumer participants in the focus groups is its inert quality. This was mentioned as being important with regard to storage. Participants reported that they would be happy to store previously opened glass containers in the fridge, whereas with other types of container they would transfer the materials for storage. It also relates to people being happier to eat from glass containers than other types of material. Participants also reported that the contents of glass containers tasted better. This was particularly the case for beer when drunk from a bottle as opposed to a can. This may be a particularly important feature for more expensive beers that are more likely to be purchased for taste reasons. Relating to this, glass allows the contents to be seen, helping the consumer assess the quality and quantity of the product. In the focus groups consumers sometimes felt that products appeared more appealing in the pictures on product labels on tins. However, advantages for glass were found for an 'appetising contents' scale in an additional section of the 'baseline profiling' study. Although, as discussed in Section 6, some caution should be exercised when interpreting these results because products were not visible in some of the 'alternative material' containers tested. Interestingly, there was no reliable difference, in the 'baseline profiling' study, between scores for glass and those for alternative materials on the 'pure' scale.

4.12.2 Group differences

In focus groups few sex differences we identified in perceptions of glass containers. However, in the 'baseline profiling' study interactions between sex, container material (glass versus alternatives), and product type were identified for responses to questionnaire scales that reflect affective responses. Patterns of means were complex (see Section 6) but, for example, women reported more favourable emotional responses to glass beer bottles than alternatives, whereas the reverse was true for men.

With regard to age differences, results from the 'baseline profiling' study again suggest that any effects of container material type also depend on product type. For example, the older group reported a greater purchase preference for glass beer bottles rather than cans. Somewhat consistent with this, in the focus groups, the older group reported that they did not like drinking out of containers. Responses were somewhat mixed for glass containers, but this was certainly the case for cans. For younger participants attitudes were context dependent. Being seen with glass was reported as important to younger consumers in the context of clubs, expensive parties and bars, where they did not want to be seen holding a can. However many younger participants were very happy to select tin cans for purchase at home or for a rowdy party. Focus group responses also suggested that older consumers would be more likely to view glass as a traditional material and less likely to view it as being 'premium' and 'sophisticated. However, this was not replicated in the quantitative assessments of the 'baseline profiling' study. Finally, the focus groups identified that older consumers were more concerned with ease of opening glass containers, and potential problems posed by arthritis. This was generally regarded as a negative feature of glass packaging by this age group. The physical requirements of opening glass packaging are relatively more difficult for this age group.

4.12.3 Opinions of light weighting of glass

Weight of glass containers is a variable that is obviously of particular importance in the context of this report. For brand owners and manufacturers it relates to manufacture and transportation costs. In the focus groups, container weight was not identified as a major practicality issue for consumers. Although associated difficulties of transportation were mentioned, this only seemed to be a factor for the younger focus groups and may relate to the availability of cars. Many without cars felt a preference for non-glass products because of the weight of the glass and the ease of breaking on the way home. However, differences between glass and containers made from alternative materials were identified in the 'baseline profiling' study for the 'practicality' scale (a scale concerned with logistics of storing, carrying, and holding containers), with glass being rated less favourably. Similarly, in the study of vodka bottles, reported in Section 7, weight

was put forward as a negative factor by some participants because of difficulties of transportation. However, others viewed it as a positive factor because it was thought to reduce fragility. Similarly, when focus groups were presented with light-weighted glass containers, the initial concerns were related to fragility and safety. Consumers wanted to know whether light-weighted glass would break more easily and, if it did break, what sort of pieces would be produced – particularly, whether thin, dangerous slivers of glass would be the result. From the interviews conducted, it seems that these are issues that brand owners and glass manufacturers expect to have to deal with.

Interestingly, and somewhat contrary to this concern with fragility, a common association for empty extremely light-weight wine bottles, in the younger and middle-aged focus groups, was with plastic. Some consumers initially wondered if the containers were made of plastic, others comments on a perception of them being 'plasticy'. This might be explained in terms of the container being lighter than they believed could/would be achieved with glass or lighter than they expected for glass. This does not seem to be a positive association from the perspective of brand owners and manufacturers. It would seem that the association with plastic has not improved safety perceptions (one of the key advantages of plastic) and yet is likely to have a disadvantageous effect with respect to perceptions of prestige and quality, constructs for which glass is generally thought to have advantages over plastic.

When asked about the types of products that light-weighted glass might be suitable for, most focus groups did not see weight as being a restriction and felt that it would be suitable for expensive, premium products as well as the value end of the market. However, when questioned further, the younger and middle-aged groups did report the expected associations between weight and prestige/quality/value, or simply expressed a preference for heavier glass without being able to rationalise this. Again, this seems consistent with concerns expressed by brand owners in the interviews. On a positive note, the strength of effect may have been less than might have been anticipated. To some extent it was product specific, with premium, expensive 'self treat' products or gifts, such as Whisky and Champagne, being most susceptible to loss of 'premium' glass associations. Also, this may be age group specific, with the older age group taking a more pragmatic view. This might relate to differences, mentioned above, such that associations with 'tradition' are more important than associations with 'prestige' for the older group. However, the study reported in Section 7 does provide a note of caution. In this study, lighter weight vodka bottles were regarded as being more fragile, but if participants noticed the weight difference, then lighter weight glass produced adverse effects on ratings for 'quality', 'pure', 'positive affect', and 'appetising contents' scales.

Many participants in the focus groups thought that they would fail to detect light weighted containers when they were full, and that the likelihood of detection was further reduced if products were experienced in a supermarket context, alongside others on a shelf, without direct comparisons. A series of studies were conducted to examine consumers' sensitivity to differences in container weight. These studies varied in the number of trials (repeated judgements that consumers made). From these, it would seem that even if consumers are expecting a weight difference they struggle to detect 5%-10% differences in container (glass) weight when the containers are filled. Moreover, in a further study, when no weight difference was anticipated over half of the sample of 32 participants did not identify a weight difference in the region of 40% of the empty container and 20% of the full container. As discussed in Section 7, there are issues to consider relating to the extent to which experimental participants are misdirected (i.e., not led to focus on weight as a manipulated factor), but nevertheless, this seems encouraging for the possibilities of progressive light weighting. Indeed, this seems to support current industry practice, in that many products have been progressively light weighted, with customers apparently unaware and with no apparent adverse effect on consumer responses as far as we know. Further to this, an in-store observation study (see Section 5) indicated that consumers' in-store purchase behaviour presents them with few opportunities for direct weight comparisons. This may be somewhat product dependent. For example, slightly more containers were taken from the shelf when selecting wine. However, when coupled with the results of the psychophysics studies, and particularly 'un-cued' detection performance, it seems to support the potential for weight differences to go unnoticed.

Finally, it is worth noting that in all studies, when consumers have been made aware of the environmental advantages of light-weighting they have taken a positive view of this. It was often remarked that light weighted containers would be acceptable if the environmental benefits and reasons for light weighting were made obvious.

4.12.4 Implications of this work and future directions

It should be noted that the brief for this project work-stream was to test consumer perceptions of 'on-shelf' products. Results should not be extrapolated beyond this setting. It is suggested that a broader assessment of consumers' responses to container weight, one that incorporates in-use/part filled assessments, would be a valuable complement to the results reported here. There are a number of complicating variables. For example, when in use, some product types will provide more opportunity than others for consumers to experience empty containers and therefore become aware of light-weighting. Containers for some product types, e.g., beer bottles, will tend to be held over extended periods and experienced with varying quantities of product. For other product types, e.g., cook-in-sauces, the product may be emptied from the container quickly, producing a more limited experience of the empty container. The in-use stress applied to containers is another factor that may vary and lead to different consumer assessments of light-weighting. For

example, using a knife to remove jam from a glass container may serve to highlight container wall thickness/thinness. Results from the reported studies also highlight that consumers will prioritise different values depending on context of use. In some settings (e.g., a bottle of wine taken to a dinner party) quality may be given a high priority, in other settings issues relating to, e.g., practicality may be prioritised. An investigation of the effects of factors such as these on consumers' responses to light weight container designs would be useful.

As might be expected, results of the studies reported here indicated that reduced glass container weight does seem to be associated with perceptions of increased fragility and practicality (carrying, holding, storing). Perhaps more importantly, results would also indicate that if a weight difference is noticed, reduced weight has negative effects on other consumer perceptions including associations of quality (see Section 7). As mentioned above, it may be that in certain contexts of use this is not a key factor for the consumer. Nevertheless, it should be of concern to brand owners and manufacturers. Related to this, some of the properties of glass containers that seem to be appreciated by consumers are those that will tend to add weight (e.g., shape and embossing) (see Sections 4 and 6).

However, when considering in-store consumer perceptions, the results reported (see Sections 5 and 7) suggest that reasonably substantial weight reductions may go unnoticed. This is partly due to the consumers' ability (or lack of it) to detect small weight changes, and partly due to lack of opportunities (given observed shopping behaviours) to make effective weight comparisons. Ability to detect may be further hampered if products within a category also vary in weight of contents.

From this, we would suggest two approaches for the continued light-weighting of glass containers. The first is consistent with current practice and involves further light-weighting by 'stealth'. Given that consumers (at least at the point of sale) do not seem to be particularly sensitive to weight differences further progress may be made in this fashion.

Second, where this is not thought appropriate or feasible, light weighting should be considered on a product specific basis. Results of studies reported here (see Section 6) do not support a generic solution (although substantial height reductions may be inadvisable). Consumers, particularly in some product areas, may be sensitive to the shape changes that are likely to accompany light weighting. It is recommended, therefore, that design revisions proceed in an iterative fashion with integrated consumer testing. It is possible that tradeoffs can be identified, such that any negative effects that might result from consumer perceptions of reduced weight can be offset by the incorporation within the design of other, more favourably perceived, features.

5 Production and Filling Trials

5.1 The Product Development Process

The production of a new or modified container involves several stages spanning the original concept to eventual full-scale manufacture.

The typical process used to develop a new container is illustrated below.

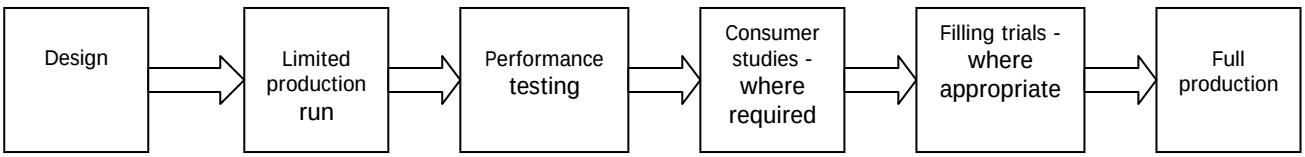


Figure 5-1: Development process used for light-weighting container glass

Each stage requires agreement between stakeholders including the brand owner, glass manufacturer and the filler/packers, and these sometimes protracted consultations can result in a long lead time in the introduction of new products.

Having identified items capable of being light-weighted, competed all the detailed design work and addressed all the brand owner's concerns, the next stage in the light-weighting process is the actual manufacturing process. Glass containers are formed in cast iron moulds by multi-section so-called IS machines. The machines vary in size and complexity, the largest able to run 40 moulds simultaneously. The production of a full set of moulds and ancillary equipment represents a very significant investment which could exceed £50,000 for the larger machines. The

introduction of a new (or modified) product is therefore normally preceded by the production of a limited run from a single or small number of mould sets. A trial run will then produce sufficient items to permit product testing and trials at the filling line. Success at this stage should lead to a decision to “tool up” to produce a full set of mould equipment.

During the course of the project this stage was achieved by 4 glass manufacturing companies and involved a total of 10 items as detailed below.

Glass Manufacturing Company	Light-weighted Item
Allied Glass	Lea & Perrins 290 ml
	Lea & Perrins 150 ml
	Generic Spirit bottle 70cl
	Generic Spirit bottle 1.5l
Beatson Clark	Seven Seas Cod liver Oil 170 ml
	Seven Seas Cod liver Oil 450 ml
O-I	Grolsch beer 330 ml
	Coors FineLite
Quinn Glass	Generic wine bottle 75cl

Table 5-1 ContainerLite Project - Manufacturing Trials

Details of each trial, the reduction in container weight and the resultant tonnages diverted from the waste stream are given below.

5.2 Individual Company Trials

5.2.1 Allied Glass

Allied Glass Containers is the UK's fourth largest glass container producing quality clear glass bottles, jars and containers food and drink products and number many brand leaders amongst their customer base.

5.2.1.1 Lea & Perrins 290 and 150 ml bottles

[pending approval to include image]

The Lea & Perrins brand is the world's number-one Worcestershire Sauce and the market leader in the United Kingdom, United States and Canada. The combined UK sales of the L & P 150 and 270ml products are currently estimated at 27 million units.

Lea & Perrins is a United Kingdom food company, originating in Worcester with a subsidiary in the United States which manufactures Lea & Perrins in New Jersey. Lea & Perrins is manufactured in Britain by HP Foods, Ltd. and in the United States by Lea & Perrins, Inc. Both the British and American companies are now owned by Heinz after being bought from previous owner Danone in 2005.

L&P is marketed in product two sizes; 150 and 270ml and both were light-weighted during the project realising weight reductions of 11% and 19% respectively.

Details of the unit weight reductions achieved and associated glass savings are given below;

Item	Initial Weight (g)	Final Weight (g)	Annual savings (tonnes)
Lea & Perrins 290 ml	247	220	297
Lea & Perrins 150 ml	166	135	496

5.2.1.2 1.5l and 75cl generic wine bottles

[pending approval to include image]

The production of UK spirit bottles exceeds 500,000 tonnes per year. Whilst many leading brands are sold in bespoke bottles and destined for export a significant volume of liquor is bottled in generic bottles and sold domestically via the various off-trade outlets including the rapidly growing supermarket spirits trade. The manufacture of spirit bottles is one of Allied Glass's major markets and their production comprises a sizable proportion of the UK's total output. Allied undertook a general light-weighting programme of their spirit production and were able to produce a "best in class" version of their generic 70cl and 1.5l bottles. The new bottles did not initially replace heavier versions but were added to Allied's portfolio and made available for customers. The new bottles have begun to find favour with Allied's customers and both are now in circulation.

Details of the unit weight reductions achieved and associated glass savings are given below;

Item	Initial Weight (g)	Final Weight (g)	Annual savings (tonnes)
Generic Spirit bottle 70cl	450	340	4500
Generic Spirit bottle 1.5	800	710	224
Generic Spirit bottle 1.5l	825	710	64

Table 5-2 Allied Glass – Light-weighting Savings

5.2.2 Beatson Clark

Beatson Clark specialise in providing packaging solutions for niche brands, and complete product lines for customers with variable needs. Beatson originally identified the cod liver oil bottles as a suitable candidate for light-weighting along with a square condiment jar. Design work was successfully completed on all the items but unfortunately unrelated events stalled the progress of the condiment jar.

5.2.2.1 Seven Seas Cod Liver Oil 170 & 450 ml bottles

[pending approval to include image]

Cod liver oil is one of the best selling supplements in the UK market and Seven Seas is the brand leader with a 21 per cent share of the total VMS category. Seven Seas is owned by the German company Merck KgaA and is part of its consumer healthcare division.

The cod liver oil is sold in 2 product sizes; 170 & 450 ml and both were light-weighted during the project realising weight reductions of 9 and 5% respectively.

Details of the unit weight reductions achieved and associated glass savings are given below;

Item	Initial Weight (g)	Final Weight (g)	Annual savings (tonnes)
Cod liver oil 170 ml	193	176	24
Cod liver oil 450 ml	365	345	16

Table 5-3 Beatson Clark – Light-weighting Savings

5.2.3 Owens-Illinois (O-I)

O-I is the largest manufacturer of glass containers in the world, with leading positions in Europe, North America, Asia Pacific and South America. In all, O-I has glass container manufacturing operations in 22 countries, including its headquarters in the U.S. Its UK operation centres on 2 large plants located at Harlow and Alloa.

5.2.3.1 Grolsch 300 ml beer

[to insert Grolsch image]

Grolsch is an international premium beer of Dutch origin and has a significant share of the highly completive UK beer market. Brand image is considered to be of particular importance in this market and thus the decision by Coors to contemplate a change to an established brand was most welcome. From the onset Coors were extremely enthusiastic about the need to minimise packaging and asked O-I to produce a range of designs; even giving them freedom to consider radical changes to the bottle's the established shape. O-I duly produced a conceptual range of potential new

containers for Coor's consideration. The range included a squat Euro-beer type design which would have represented a total departure from the established brand shape. The new designs were subjected to rigorous consumer perception trials before Coors opted for a design that sacrificed a little height but essentially retained the classic profile but with a 15% weight reduction. The new bottle was introduced for the 300ml premium larger product which has significant presence in the UK off-trade (9% of off-trade bottled larger). The new 190g bottle represents a 14% saving from its heavier predecessor and, with annual sales of 150 million units, this equates to an aggregated saving of 4,500 tonnes per year.

Details of the unit weight reductions achieved and associated glass savings are given below;

Item	Initial Weight (g)	Final Weight (g)	Annual savings (tonnes)
Grolsch 330 ml premium	220	190	4,500

Table 5-4 O-I – Light-weighting Savings

5.2.4 Quinn Glass

[pending approval to include image]

Quinn Glass is relative new comer to the UK glass manufacturing family beginning operation in 1998 with a greenfield facility in Northern Island. A second large facility was commissioned in May 2005 on the site of the redundant Ince B power station at near Chester. The new plant is one of only a handful world-wide to incorporate filling facilities and, in addition, the site houses one of the largest automated warehouses in Europe, capable of handling 282,000 pallets of filled and unfilled glass containers. The burgeoning wine trade is one of Quinn's principal target business areas and the plant's capabilities allows it to compete for the trade generated by the bulk importation of wine.
Shipping wine in bulk for subsequent UK filling brings several environmental benefits including: reduced transport impacts, helping to redress the UK's cullet colour imbalance by providing a high value market for green glass, and, by substituting lighter UK produced bottles for their generally heavier overseas counterparts, reducing the flow of glass to the domestic waste stream. Surveys of the weights of imported wine bottle show a huge variation in bottle weights ranging from 300g to over 800g. The results of such a survey are given in Figure ?? The average imported bottle weight recorded in the survey was 510g.

The wine bottles presently produced by Quinn Glass have an average weight of 400g i.e. are on average 22% lighter than the overseas bottles that they displace. The Quinn facility is currently in the process of "ramping up" its production and, based on the latest production data, Quinn calculate that their lighter bottles have yielded savings of 20,000 tonnes per year. If, as Quinn confidently anticipate, the wine business is expanded in line with their forecasts the glass saving will significantly increase.

The 400g bottle does not however represent Quinn's final ambition. A 300g wine bottle is in production, albeit in a somewhat non-classical design. Quinn have stated that it is their intention to aspire to this "best in class" weight but will probably produce a bottle in the 330 -350g range as a precursor.

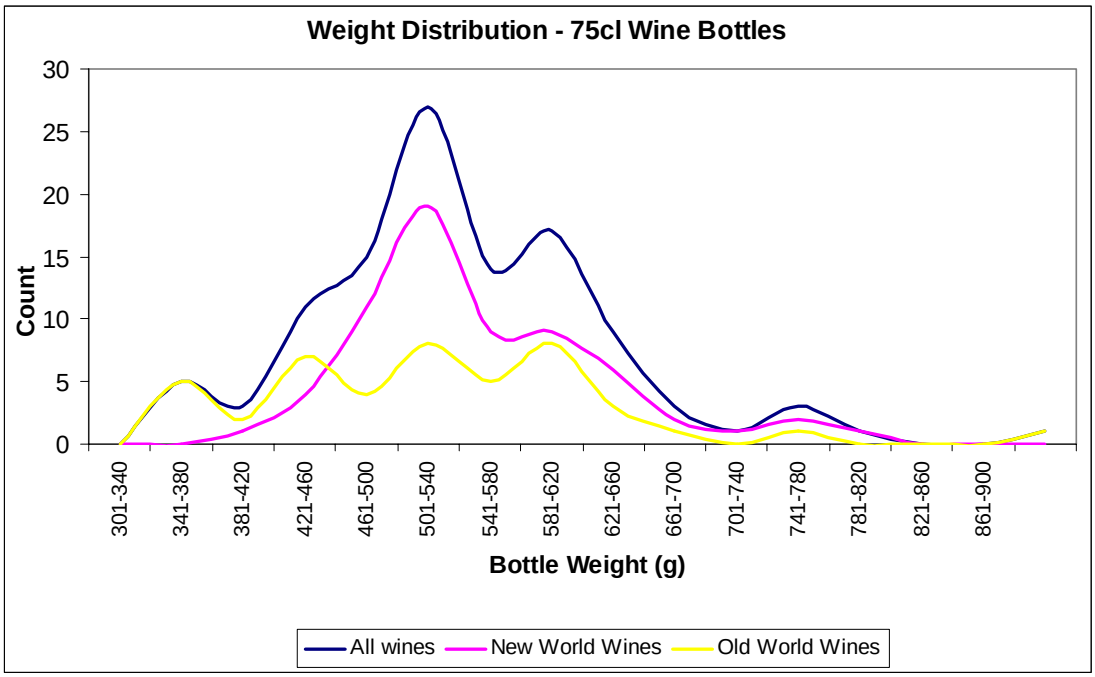


Figure 5-2 Weight Distribution of Imported Wine Bottles.

Details of the unit weight reductions achieved and associated glass savings are given below;

Item	Initial Weight (g)[1]	Final Weight (g)	Annual savings (tonnes)[2]
75cl wine bottle	510	400	20,000

[1] average weight of imported bottle [2] Calculated from current production

Table 5-5 Quinn Glass – Light-weighting Savings

6 Performance Testing

All glass containers produced by UK manufacturers undergo an extensive range of tests as an integral part of the manufacturing process. Much of the testing is fully automated and applied to every item manufactured. Other, more time consuming tests are performed on a sample basis. In addition to all these routine tests some of the containers selected for the light-weighting programme; those which had undergone a more significant change, were subjected to an additional level of scrutiny involving a wider range of tests at the GTS product evaluation facility.

In the event GTS tested seven products, these being:

Generic 70cl Whisky bottle	-	Standard
	-	Lightweight
	-	“SuperLite”
450 ml Cod liver Oil	-	Standard
	-	Lightweight
170 ml Cod liver Oil	-	Standard
	-	Lightweight

The additional GTS testing regime applied to these products comprised:

- ✓ Vertical Load Testing
- ✓ Impact Testing - Heel and Shoulder
- ✓ Thermal Shock Testing
- ✓ Annealing
- ✓ Glass Thickness
- ✓ Slip Angles and Hot End Coating Measurements
- ✓ Capacity
- ✓ Dimensional Analysis

A comprehensive test report was issued for each product tested. A summary of these results is given in Appendix??

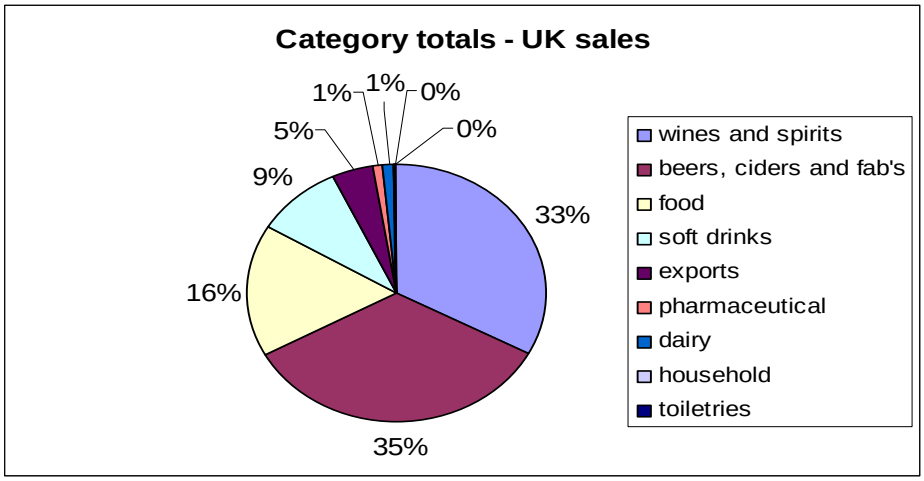
7 Market Survey

Leeds University Business School were tasked with developing a comprehensive understanding of the UK glass market and specifically, identifying the leading glass packaged brands manufactured and sold in the UK. This research was intended for use during the dissemination activities of the project in targeting those brands comprising the largest market shares in a range of product areas. Targeting these brands in future light-weighting activity will help maximise the tonnage reductions that may be made. Due to the limitations inherent within the project in concentrating activity with UK based glass manufacturers, imported containers were not included in the analysis.

The objective of the Market survey undertaken by University of Leeds Business School was to identify those companies whose brand share of a market was such that their involvement in the project would significantly increase the capacity for tonnage reduction.

Initial findings determined that the key product areas for focus were beers, spirits, FAB's (Flavoured Alcoholic Beverages) and Food as shown on the following Figure 7-1.

Figure 7-1: Category Totals UK Sales



Analyses of each of these categories was carried out to determine the top brands within each.

The following are pertinent extracts from the Market survey highlighting the key issues identified.

7.1 Methodology

The project methodology adopted is predominantly based on the analysis of secondary data. The aim of the data analysis was first and foremost to determine the glass containers for which light-weight application would be most feasible. Subsequent to this, data analysis is used to select product lines, and container sizes, for recommendation of further light-weight glass pilot testing. Therefore, the order of the focus of data analysis is depicted in Figure 7-2.

Figure 7-2: Overview of stepwise data collection for project

Information was gathered from a number of different sources, broadly reflective of the stepwise data collection method outlined above. Each information source served a particular strategic purpose within this audit.

1. Current volumes of total glass manufactured in the UK and the breakdown by glass category into container, flat, specialist, fibre and domestic types (British Glass).

2. Breakdown of the aforementioned glass types for the glass container or packaging industry (British Glass).

3. The cross sector assessment of relative tonnes of packaging or container glass to determine percentages for the food and drinks sectors primarily, with a purpose of further breaking down the data within each of these sectors identified (British Glass and Exel).

4. An assessment of current trends within the identified product sectors, and highlights of market shares of leading brand names within each product category (Mintel).

5. In addition to detailed brand share/volume data, supermarket fixture analysis, was conducted in the identification of the most feasible product lines and container sizes for pilot testing (Mintel and Retail Audits).

7.2 Key Findings

One of the key challenges facing the UK packaging sector is the current low level of recycling rates relative to European counterparts. This project specifically addresses the issue of the sustainable production and consumption of glass packaged products, focussing on the feasibility of reduced or light weighted glass packaging.

A number of product lines are identified as part of this market audit for potential light weighting application. These product lines with possible weight reductions and subsequent glass tonnage savings are presented as part of the audit report. Throughout this report, the WRAP waste reduction target of 310,000 tonnes is of primary concern.

The results of this audit, including a proposed list of 33 nominated glass containers drawn from the alcohol (bottled lager, FAB's, spirits and wine) and food categories (coffee, ketchup and cooking sauces), suggest glass tonnage savings through light-weighting of 25,562 tonnes (at 10%), 51,124 tonnes (at 20%), and 76,687 tonnes (at 30%) respectively. Detailed breakdowns of these calculations are as follows.

7.3 Food containers:

Within the food containers (Figure 7-3, below) instant coffee, sauces, cook in sauces, jams and pickles and chutneys form 75% of all food containers.

Figure 7-3: Food Categories and Glass container tonnage usage (2004); Source: British Glass

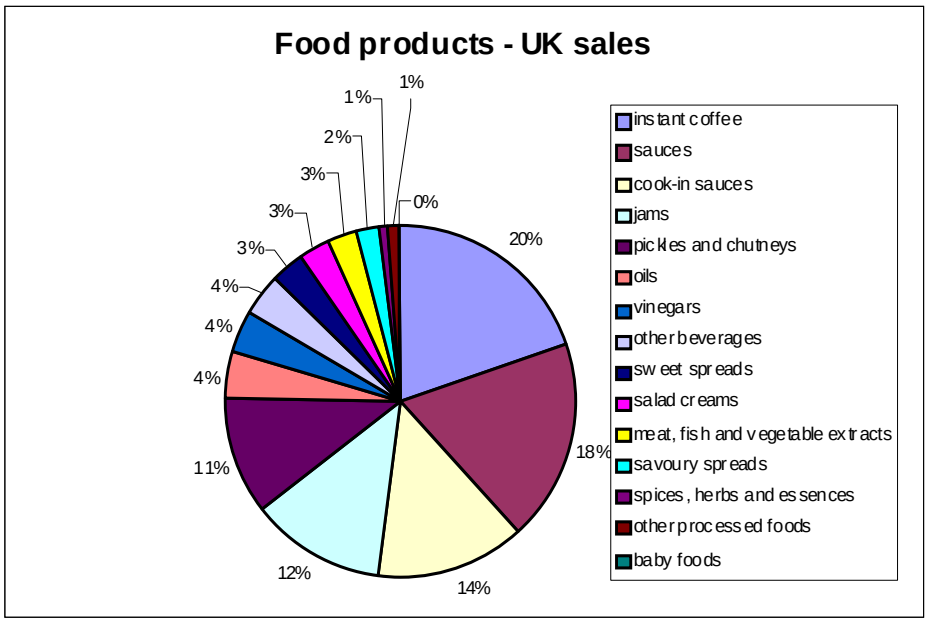


Table 7-1 below indicates that projected savings for five selected product lines drawn from the coffee and ketchup categories could amount to glass tonnage savings of 3,757 tonnes for a 10% glass weight reduction, 7,515 tonnes for a 20% glass weight reduction and finally 11,273 tonnes for a 30% glass weight reduction. The total coffee market is expected to grow by 9% from 2004 to 2009. Assuming consistent market share, the total glass savings in 2009 can be estimated in the range of 4,096 tonnes (10% trial) to 12,288 tonnes (30% trial).

Table 7-1: Breakdown of glass weight savings
Source: Mintel, Coffee UK, January 2004 and Mintel, Bottled Sauces UK, November 2004

Brand	Sales Value (2003) £m [2]	No. Of Bottles (m)[3]	Container Weight (gm)	Total Weight (Tonnes)	Tonnage Trial		
					10%	20%	30%
Nescafe Original (100gm)	80	45	225	10,125	1,012	2,025	3,037
Nescafe Original (200gm)	141	39	438	17,082	1,708	3,416	5,124
Kenco Really Smooth (100 gm)	17	8	185	1,480	148	296	444
Kenco Really Smooth (200 gm)	30	7	413	2,891	289	578	867
Daddies (340 g)[4]	13	25	240	6,000	600	1,200	1,800
TOTAL				**37,578**	**3,757**	**7,515**	**11,273**

Table 7-2 following also belongs to the food sector, and illustrates savings for the top eight selected product lines drawn from the 'cooking sauces' category. The eight selected lines should be able to deliver glass savings of between 5931 tonnes (at 10%) and 17793 (at 30%). The total market of cooking sauces is expected to grow by 23% by 2009 and assuming the consistent market share, the total amount of glass savings in 2009 can be estimated in the range of 7296 (at 10%) to 2266 at (30%) tonnes.

Table 7-2: Breakdown of glass weight savings: cooking Sauces (2004)
Source: Mintel, Cooking Sauces - UK - December 2004

Brand	Sales Value (2004) m £[5]	No. Of Bottles (m)[6]	Container Weight (gm)	Total Weight (Tonnes)	Tonnage Trial		
					10%	20%	30%
Pasta							
Dolmio-Master Foods (500gm)	92	62.59	252	15,771.43	1,577.14	3,154.29	4,731.43
Ragu-Unilever (500gm)	25[7]	22.73	252	5,727.27	572.73	1,145.45	1,718.18
Bertolli-Unilever (500gm)	15[8]	8.88	222	1,970.41	197.04	394.08	591.12
Lloyd Grossman- Chivers Hartley (350gm)	16	9.88	236	2,330.86	233.09	466.17	699.26
Non Pasta							
Homepride-Campbell Grocery products (500 gm)	60	44.44	280	12,444.44	1,244.44	2,488.89	3,733.33
Knorr-Unilever (500 gm)	57	48.72	252	12,276.92	1,227.69	2,455.38	3,683.08
Sharwoods-Centura Foods (420 gm)	29	20.00	212	4,240.00	424.00	848.00	1,272.00

[2] Source: Mintel, Coffee UK-January 2004 and Daddies reference
[3] Container weights obtained through supermarket audit undertaken by LUBS staff during summer 2005. Total containers old obtained by dividing RSP price by the total sales value
[4] Daddies include tomato ketchup and brown sauce
[5] Source: Mintel Report
[6] Based on super market audit and obtained by Mintel Sales Value divided by RSP.
[7] Estimated split between brands owned by Unilever
8 Estimated split between brands owned by Unilever

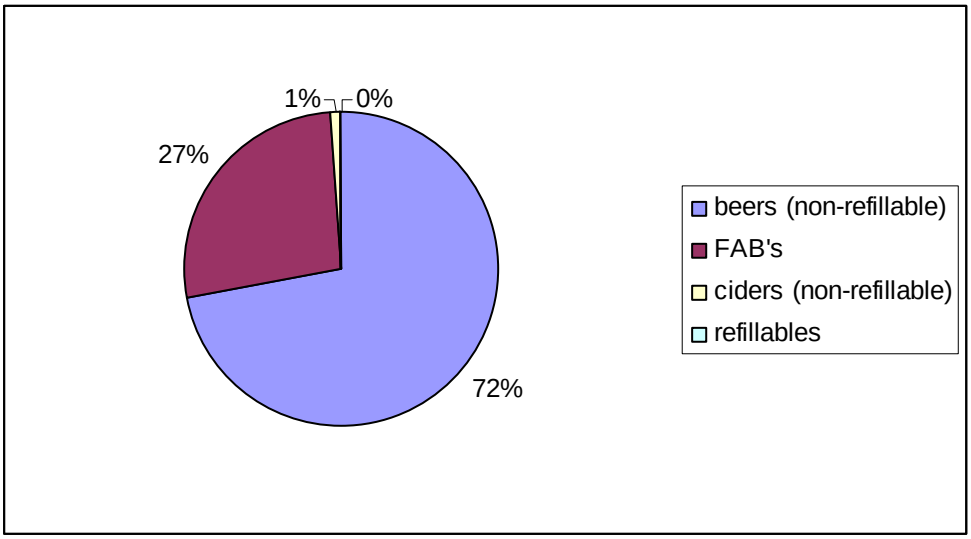
Uncle Ben's-Master Foods (490 gm)	24	16.55	275	4,551.72	455.17	910.34	1,365.52
Total				**59,313.07**	**5,931.31**	**11,862.61**	**17,793.92**

Based on the supermarket audit and the information supplied by the group members, it can be stated with reasonable confidence that containers for the above Cooking Sauces are produced in the UK and can contribute to a weight reduction in the range of 5,931 tonnes (10% tonnage trial) to 17,793 tonnes (30% tonnage trial). However, it should be noted the brand owners might have more than one supplier with container being sourced from a number of glass suppliers. Considering this factor, the list of top eight brands has been presented here so as to identify the potential candidate for glass weight reduction.

7.4 Beers, Ciders and FAB's

A breakdown of the total tonnage of glass used in the United Kingdom home-produced containers in 2004 revealed that one of the major sectors, which accounted for about 35% of glass tonnage is "Beers, ciders and FAB's" followed by "wines and spirits" accounting for 33% and "food" by 16% (Graph:2). Keeping this factor in mind, this category was further broken down in to three sub categories Beers, ciders and FAB's. As can be seen in the graph:4 below, beer is one of the high volume sales categories and constitutes 72% of total sales with FAB's and ciders contributing 27% and 1% respectively (Figure 7-4: %age of glass used in the UK beer, cider and FAB's sales (2004) Source: British Glass). These figures make this category a strong candidate for trial light-weighting and has huge potential savings for glass weight reductions. Following this analysis, work has concentrated on bottled lager and FAB's with ciders excluded.

Figure 7-4: %age of glass used in the UK beer, cider and FAB's sales (2004)
Source: British Glass

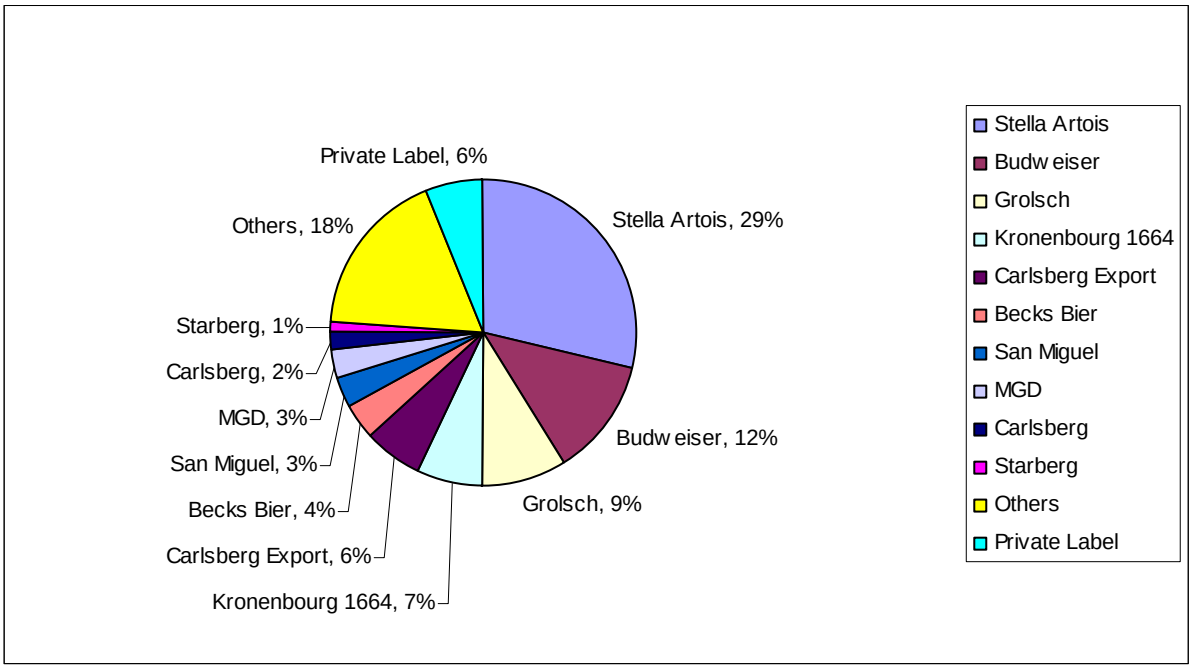


7.5 Bottled Lager Market in UK

Lager accounts for 70% of the total beer market by volume, with 50% of the population consuming lager. This trend is expected to continue with lager predicted to represent 80% of volume sales by 2010 (Mintel: Lager-UK. October 2005). The market is consolidated, with five large brewers accounting for 83% of volume in 2004 across both on and off trade. Carling is market leader with around 18%, followed by Fosters at 15%, Stella Artois at 14.6% and Carlsberg at 9.2%.

Focusing on the bottled off-trade sector, which is estimated at 425 million litres (A.C.Nielsen Scan Track 2005) with the top ten brands accounting for 75% of the total off-trade market. Stella Artois is market leader accounting for 29%, approximately 380m bottles (see Figure 7-5, below). Second and third brands being Budweiser (12%) and Grolsch (9%).

Figure 7-5: Top Bottled Lager Brands by Volume 2005 (Off Trade)
Source: ACNielson ScanTrack



The trend towards home drinking is anticipated to continue with supermarket promotions and competitive pricing. Changing lifestyles and growing varieties of home based entertainment have impacted positively on off-trade volumes currently at 38% in this sector. A Target Group Index survey run throughout the year to collect continuous data by the British Market Research Bureau (BMRB) of 25,000 adults revealed that the percentage of consumers 'who do most of their drinking at home' has increased from 40% in 2002 to 48% in 2004 (quoted in Mintel, Lager UK 2005). The BBPA (British Beverage and Pub Association) estimates that by 2010, the off-trade sales volume would exceed the on-trade sales of alcoholic drinks.

According to Mintel (Mintel Lager-UK-Feb. 2000; June 2005) bottled lager packaging has continued to grow against cans in the off-trade. Bottled lager reflects lifestyle segments that perceive superior taste, quality and image associations. Hence bottled lager is expected to continue to increase glass consumption. Whilst volume sales have increased, the sales value of bottled lager fell by 11% from 2002 -2004. This indicates lower unit prices and sales promotions are driving increasing bottle sales and consequently increasing waste tonnage.

Bottled lager is available in a range of sizes from 200ml to 3 litre bottles with the 330ml being currently the best selling package size with 49% market share, followed by 300ml at 17% and 250ml at 15%. At the brand level there are varying bottle sizes available to consumers. Stella Artois, Budweiser and Carlsberg Export sell predominantly 330ml bottles. The 300ml bottle is the fastest growing bottle size in preference to 330ml and is the leading glass container for Grolsch and Kronenberg. It is worth noting that whilst some brands concentrate on single pack sizes (MGD and Carlsberg) others such as San Miguel show sales distributed over three sizes with high sales (5 million) of 1 litre bottles, equivalent to approximately 15 million 330ml bottles. This clearly impacts on glass tonnage waste for recycling.

Table 7-3 below gives the break down of bottled lager sales volume by bottle size with unit estimates for each bottle size. To achieve these estimates the sales volume was converted from barrels to gallons and then gallons to litres. Based on these calculations it is estimated that 1265m lager bottles were sold in 2005. (49% 330ml / 17% 300ml / 15% 250ml) Considering these findings the prime bottle sizes for weight reduction to maximise savings are the 330ml and 300ml sizes (the latter is expected to become the leading bottle size within the next few years)

Table 7-3: Break down of glass weight savings
Source: Mintel Lager-UK-Feb. 2000; June 2005

Brand	Bottle Size (ML)	No. Of Bottles m)[9]	Container Weight (g)	Total Weight (Tonnes)	Tonnage Trial		
					10%	20%	30%
Stella Artois	330	254.94	203	51,752.82	5,175.28	10,350.56	15,525.85
Budweiser	330	119.90	205	24,579.50	2,457.95	4,915.90	7,373.85
Grolsch	300	113.04	230	25,999.20	2,599.92	5,199.84	7,799.76
Kronenbourg 1664	300	72.33	222	16,057.26	1,605.73	3,211.45	4,817.18
Carlsberg Export	330	35.80	245	8,771.00	877.10	1,754.20	2,631.30
Becks	275	50.82	188	9,554.16	955.42	1,910.83	2,866.25
San Miguel	330	20.24	232	4,695.68	469.57	939.14	1,408.70
MGD (330ml)	330	35.52	230	8,169.60	816.96	1,633.92	2,450.88
Carlsberg	275	33.65	220	7,403.00	740.30	1,480.60	2,220.90
Starberg	250	25.18	219[10]	5,525.61	552.56	1,105.12	1,657.68
TOTAL (Top ten; Off trade)	N/a	761.42	N/A	162,507.83	16,250.78	32,501.57	48,752.35
Other Brands/bottles (off trade)		499.08[11]	219[12]	109,520.33	10,952.03	21,904.07	32,856.10
TOTAL Off Trade (38%)	38%[13]	1260.5[14]	N/a	272,028.16	27,202.82	54,405.63	81,608.45
TOTAL On Trade (62%)	62%	2056.61	N/a	443,835.43	44,383.54	88,767.09	133,150.63
TOTAL BOTTLED LAGER	**100%**	**3317.11**[15]	N/a	**715,863.6**	**71,586.36**	**143,172.72**	**214,759.08**
Off Trade (Top 10, with given bottle Size)	38%	761.42	N/a	162,507.83	16,250.78	32,501.57	48,752.35
On Trade (Top 10 with given bottle Size)	62%	1242.32	N/a	265,144.36	26,514.44	53,028.87	79,543.31
Off Trade (Other Brands including other bottle sizes of top ten brands)	38%	499.08	N/a	109,520.33	10,952.03	21,904.07	32,856.10
On Trade (Other Brands including other bottle sizes of top ten brands)	32%	814.29	N/a	178,691.07	17,869.11	35,738.21	53,607.32
TOTAL BOTTLED LAGER	**100%**	**3317.11**		**715,863.6**	**71,586.36**	**143,172.72**	**214,759.08**

[9] Source: AC Nielsen; Scan Track, Lager Size and Packaging (2005)
[10] Average weight of top nine bottles. Starberg bottle not available
[11] Includes other bottle sizes (other than highest selling bottles) of top ten brands (272.84 m) and all other brands (226.24m)
[12] Average weight of top ten bottles
[13] On trade:Off trade split has been taken as 62:38 (Mintel; Lager-UK-June 2005)
[14] Source: AC Nielsen; Scan Track-Top Lager Skus-Off trade (2005)
[15] Total bottled lager volume has been calculated based on the estimate of on:off trade split of 68:32 (Mintel Lager-UK_June-2005) and based in the off trade sales volume figures at brand level (AC Nielsen Top Lager Skus-Off trade). Similar approach has been used to estimate on trade sales volume.

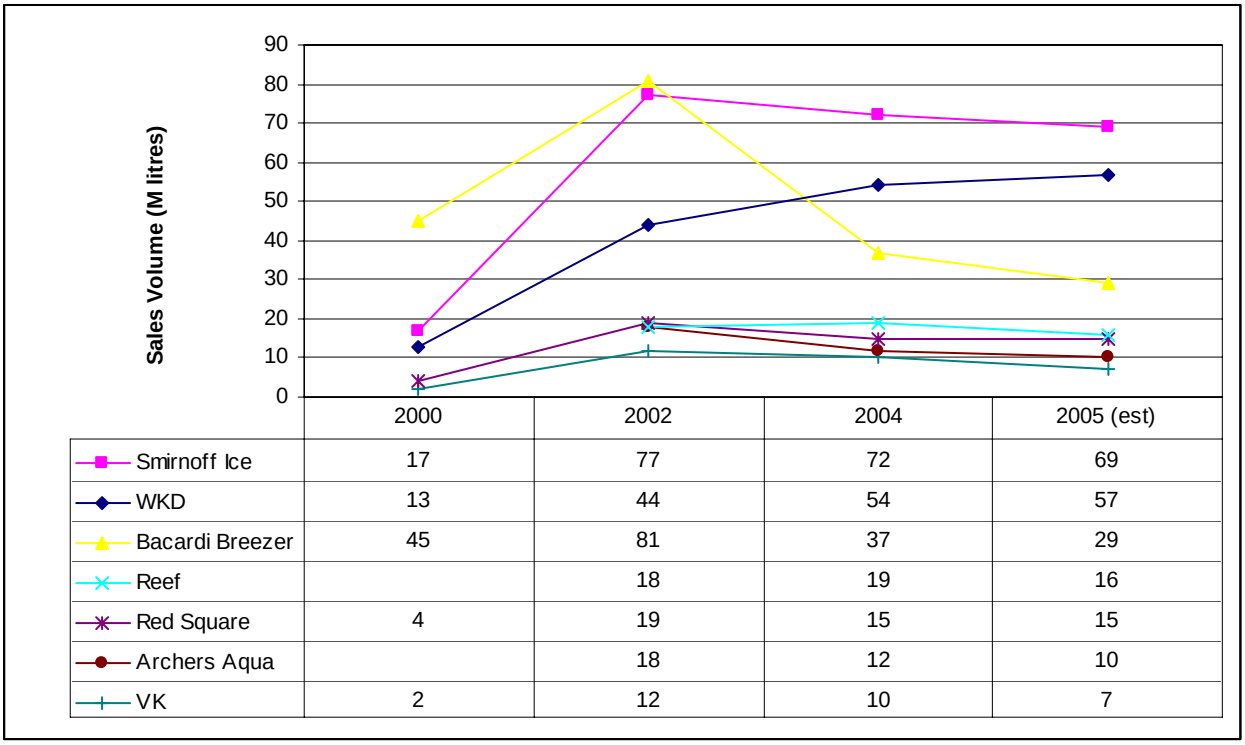
Based on the supermarket audit conducted by LUBS during summer 2005 and information supplied by consortium members including brand owners and glass manufacturers, the top ten off-trade bottled beer brands for light weighting are identified in the above Table 7-3. The greatest potential is clearly offered by Stella Artois 330ml. The top four brands are all utilising UK produced containers and have the combined potential to deliver tonnage savings in the range of 11,839 (10% tonnage trial) to 35,517 (30% tonnage trial).

The production sources for Becks and Carlsberg could not be identified due to lack of clarity of bottle markings surveyed. It should also be noted brand owners may utilise multiple sources of container production both within and outside the UK. Considering these factors potential glass weight savings have been calculated for the key brands so as to arrive at the identification of the strongest target candidates for glass weight reduction.

7.6 Flavoured Alcoholic Beverages (FAB's)

The market for flavoured alcoholic beverages (FAB) has now been established for more than a decade and has been one of the outstanding successes in the drinks market. The UK FAB market witnessed excellent value and volume growth from 1998 to 2002. However, after continuous growth, the FAB market is struggling to sustain its position in the UK drinks market in recent years. The FAB market declined from 308 m litres in 2002 to 240 m litres in 2005, reporting around a 22% fall in three years. Much of this decline can be accounted for by the dramatic decline of Bacardi Breezer as illustrated in Figure 7-6 (Mintel; FAB-UK-October, 2005). However, in spite of this recent downward trend, the UK FAB market is still a large and dynamic industry worth £1.2 billion by value and at 240 m litres by volume and is about four times greater than the vodka market (59.8 m litres in 2004). Obviously, this huge volume makes this category one of the strongest candidates for potential glass weight reduction. Bottles of FAB are quite standardised in terms of bottle size which helps to arrive at the closer estimate of the potential glass weight reduction.

Figure 7-6: UK FAB's Retail Sales Volume – Top Seven Brands (2000-2005)
Source: Mintel, FAB-UK-October 2005 (NOTE: Sales volume figures for Red and Archers Aqua for the year 2000 are not available)



	2000	2002	2004	2005 (est)
Smirnoff Ice	17	77	72	69
WKD	13	44	54	57
Bacardi Breezer	45	81	37	29
Reef		18	19	16
Red Square	4	19	15	15
Archers Aqua		18	12	10
VK	2	12	10	7

The market for FAB's is dominated by vodka based drinks (70% by volume) and white rum based drinks (16% by volume) with an increasing trend towards the Vodka category. In terms of leading players, the UK FAB market is highly dynamic and dominated by three of the largest companies, namely Diageo, Beverage Brands and Bacardi Martini with 33%, 24% and 13% of volume share respectively (Mintel; FABs-UK-October-2005). The leading brands in the sectors are; Smirnoff Ice, WKD, Bacardi Breezer, Reef, VK, Archers Aqua and Red Square (see Figure 7-6).

It should be noted that as per the Mintel forecast (Mintel; FABs-UK-October 2005) the market for FAB's will continue to decline by value. However, the decline will be at a slower rate and the volume will be stagnate hovering at around 238 to 240 m litres from 2005 to 2010 indicating a stabilisation of the market. Moreover, the increasing trend toward home drinking has increased the off trade sales volume from 34% in 2000 (Mintel; FABs-UK-2003) to 47% in 2004 which is expected to continue in future (Mintel; FAB's-UK-October-2005) resulting in a narrowing gap between off trade and on trade sales volume.

The 2005 figures in (Table 7-4) below show that seven brands constitute 85% of the total FAB market and when taken together should be expected to deliver glass savings of between 16165 tonnes (at 10%) and 48494 tonnes (at 30%)in the off-trade. It should be noted that in the FAB's category out of the top seven brands, bottles for six brands have been identified as produced in the UK. If Bacardi Breezer is excluded (source of production could not be identified) representing (2,236 to 6,707 tonnes) from the potential glass savings, we can estimate, total glass savings in the range of 14,074 (10% trial) to 42,223 (30% trial) tonnes. The off trade glass savings would be in the range of 6,615 (at 10% trial) to 19,844 (at 30% trial) tonnes. It should be noted that due to the limited availability of data, especially break down of sales volume by pack size, a standard bottle size of 275ml has been assumed (based on the average weight of the top seven brands).

Table 7-4: Breakdown of glass weight savings;
Source: Flavoured Alcoholic Beverages - UK - October 2005
Container weight based on Supermarket Audit conducted by LUBS during summer 2005)

Brand	Sales Volume (2005) est m litres[16]	No. Of Bottles (m)[17]	Container Weight (g)	Total Weight (Tonnes)	Tonnage Trial		
					10%	20%	30%
Smirnoff Ice	69	250.91	205	51,436.36	5,143.64	10,287.27	15,430.91

[16] Source: Mintel FAB's; UK- October 2005; estimated sales volume for 2005
[17] Derived by total sales volume-(litres) divided by bottles size of 275ml based on Mintel, FAB's UK, October 2005

WKD	57	207.27	230[18]	47,672.73	4,767.27	9,534.55	14,301.82
Bacardi Breezer	29	105.45	212	22,356.36	2,235.64	4,471.27	6,706.91
Reef	16	58.18	225	13,090.91	1,309.09	2,618.18	3,927.27
Red Square	15	54.55	225	12,272.73	1,227.27	2,454.55	3,681.82
Archers Aqua	10	36.36	250	9,090.91	909.09	1,818.18	2,727.27
VK	7	25.45	225	5,727.27	572.73	1,145.45	1,718.18
Total of top seven	**203**	**738.18**		**16,1647.27**	**16,164.73**	**32,329.45**	**48,494.18**
Others	37	134.55	226[19]	30,215.06	3,021.51	6,043.01	9,064.52
Total Market Size	**240**	**872.73**	**n/a**	**19,1862.34**	**19,186.23**	**38,372.47**	**57,558.70**
Off Trade (Top seven Brands); 47%	95.41	95.41[20]	n/a	75,974.22	7,597.42	15,194.84	22,792.27
On Trade (Top Seven Brands); 53%	107.59	107.59[21]	n/a	85,673.05	8,567.31	17,134.61	25,701.92
Off Trade Others	17.39	63.24	226	14,201.08	1,420.11	2,840.22	4,260.32
On Trade Others	19.61	71.31	226	16,013.98	1,601.40	3,202.80	4,804.20
Off Trade (Total Market)[22] 47%	112.8	112.8	n/a	90,175.30	9,017.53	18,035.06	27,052.59
On Trade (Total Market)[23] 53%	127.2	127.2	n/a	101,687.04	10,168.70	20,337.41	30,506.11

7.7 White Spirits

In the last decade, the UK spirit market has experienced a general shift from dark spirit to white spirit with dominating categories of vodka, gin and white rum. Reporting a growth of 29% by volume and 39% by value, the UK white spirit market has increased from 82.1 m litres in 1999 to 105.7 m litres in 2004 (Mintel; White Spirits-UK-March 2005). This makes this category an attractive category where substantial glass weight can be reduced.

In terms of packaging, the white spirit is available in four to five different pack sizes The standard bottle size of 70cl is the most popular. It should be noted that there is not any specific data available in terms of total sales volume by pack size or number of bottles of each size sold. However, in line with the study conducted by James Ross Consulting for 70cl whisky bottles (2006) , and assuming the similar trend in the white spirit market to that of whisky market, the total sales from 70cl bottles can be estimated at 44% of total sales volume, with remaining 56% volume from other sizes of bottles (Cost-Benefit analysis of opportunities in weight reduction of 70cl whiskey bottle packaging by James Ross Consulting Ltd.).

With the assumption of 44% sales volume from 70cl bottles, the total number of 70cl bottles can be estimated at 66.44m bottles with the sales volume of 46.51 m litres and the estimated glass consumption at 26,664 tonnes. In line of this assumption, the potential glass savings can be estimated in the range of 2,666 (at 10% trial) to 7999 tonnes (at 30% trial).

According to Mintel (Mintel, White Spirits UK, 2005) the UK white spirit market consists of gin, white rum and vodka. Vodka is the market leader which accounts for 57% of the white spirits market by volume (million litres) followed by gin with 25% and white rum with 14% market share respectively. In terms of brands, Smirnoff vodka, Gordon's gin, and Bacardi white rum are the market leaders in the respective categories. In terms of packaging 70cl vodka bottles accounts for total 15202 tonnes followed by gin (7,642) tonnes and white rum (3,820) tonnes.

An increasing trend towards home drinking, cheaper spirits on the off trade, combined with changing life style and improvements in home entertainment facilities, off trade sales volumes have risen in recent years which is expected to continue. The off trade accounted for 68% by volume of the total white spirits market in 2004 (Mintel; White Spirits-UK-March 2005).

[18] Source: Based on information supplied by the Steering Group Member
[19] Average weight per bottle assuming bottle size of 275ml (average weight of top seven brands)
[20] Off trade by volume; Top seven brands (Mintel; FAB's-UK-October 2005)
[21] On trade by volume; Top seven brands (Mintel; FAB's-UK-October 2005)
[22] Total on-trade and off-trade split by volume (Source: Mintel, FAB-UK-October 2005
[23] Total on-trade and off-trade split by volume (Source: Mintel, FAB-UK-October 2005

7.7.1 Gin

The UK is one of the largest exporters of gin in the world with 70% of the production distributed overseas. In terms of the UK market, the gin sector has reported an average volume growth of about 3% in last four years from 2000 to 2004). Gordon's gin dominates the gin market with a market share of 41.4% followed by Bombay Sapphire with 7% market share. Though Bombay Sapphire seems to hold a negligible market share, it is the fastest growing brand and reported a 200% increase in its sales between 2002 and 2004. It should also be noted that whilst the category as a whole, has a 70:30 off /on-trade split, Gordon's gin split is 50:50 (Mintel, White spirits, UK 2005). Mintel's British Lifestyles-UK, Special Report (2005) suggests the "home drinking" segment is increasing more quickly than that of "going to the pub for a night out" (Mintel, White Spirits UK, March 2005). Considering this the overall on-trade / off-trade split has been taken to be 30:70 and the same split has been used for the forecasting.

Table 7-5 (Mintel, White Spirits UK, March 2005) estimates the total, on trade-off trade and brand specific potential glass weight savings for gin. It should be noted that different packaging sizes and lack of precise sales figures by pack size made it difficult to arrive at more accurate estimates. Hence, the following estimates are based on an assumption of the standard pack size of 70ml for each of the categories excluding Bombay Sapphire which is a one litre standard bottle.

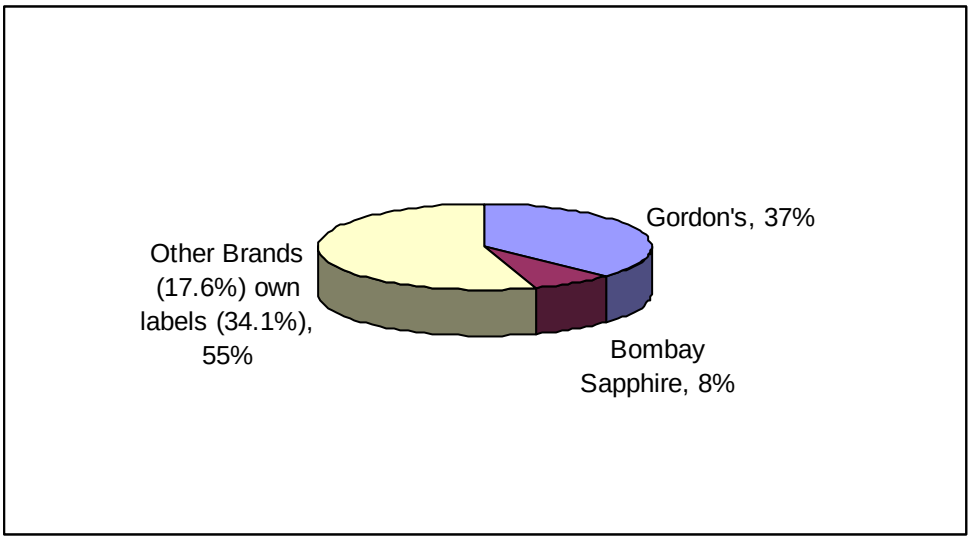
Table 7-5: Break down of glass weight savings
Source; Mintel, White Spirits UK, March 2005

Gin Brand	Sales Volume from 70cl bottles (2004) m litres[24]	No. Of 70cl Bottles (m)[25]	Weight per70cl Bottle (g)	Total Weight (Tonnes)	Tonnage Trial		
					10%	20%	30%
Gordon's	4.75	6.29	420	2,851.20	285.12	570.24	855.36
Bombay Sapphire	0.79	2.70	560	633.60	63.36	126.72	190.08
Sub total (Top two)	5.54	8.99	N/a	3,484.80	348.48	696.96	1,045.44
Other Brands including Own labels 34.1%	5.94	4.75	490[26]	4,156.06	415.61	831.21	1,246.82
Total Gin (2004)	11.48	1.54	n/a	7,640.86	764.09	1,528.17	2,292.26
Off Trade (Gordon's 50%; 70cl bottles)	2.38	2.04	420	1,425.60	142.56	285.12	427.68
On Trade (Gordon's 50%; 70cl bottles)*	2.38	0.66	420	1,425.60	142.56	285.12	427.68
Off Trade (Bombay Sapphire 68%; 70cl bottle)*	0.54	6.79	560	430.85	43.08	86.17	129.25
On Trade (Bombay Sapphire 32%; 70cl bottle)*	0.25	2.20	560	202.75	20.28	40.55	60.83
Off trade (Other Brands including Own Labels)*	4.04	6.29	490	2,826.12	282.61	565.22	847.84
On trade (Other Brands including Own Labels)*	1.90	2.70	490	1,329.94	132.99	265.99	398.98
Off Trade (Total Market)*	6.95	8.99	N/a	4,682.57	468.26	936.51	1,404.77
On Trade (Total Market)	4.53	4.75	N/a	2,958.29	295.83	591.66	887.49

[24] Derived from the "Total Sales Volume"; (Source: Mintel: White Spirits-UK-March 2005). In line with the James Ross Study for 70cl Whisky bottle, the sales volume of 70cl bottles has been estimated at 44% of the total sales volume (Mintel-white Spirit UK-March-2005)
[25] Based on the estimation of 44% of the total sales volume from 70cl bottles (James Ross study for 70cl whisky bottles)
[26] Average weight of top two brands
* Source: Mintel; White Spirits-UK-March 2005

The two top selling brands taken together could deliver glass savings between 348 tonnes (at 10%) and 1,045 tonnes (at 30%). However, the source of the glass produced for the bottles of Bombay Sapphire could not be identified and if we exclude this from the potential glass weight savings assuming it to be produced outside the UK, Gordon's gin alone can contribute to the total glass savings in the range of 285 to 855 tonnes with off trade glass savings in the range of 142 to 427 tonnes.

Figure 7-7: Weight Distribution – Gin (70cl bottles) UK (2004)
Source: Mintel, White Spirits UK, March 2005



As indicated above (Figure 7-7), 45% of the total glass packaging weight in this sector is accounted for by the Gordon's and Bombay Sapphire brands. Significantly, 18% of the packaging weight is from retailer 'own labels'.

7.7.2 White Rum

In the case of white rum, Bacardi dominates the white rum category with 70% of the market share by volume. The remaining market share is split among minor branded players and own-label and therefore are not been considered here. The following table shows the total sales volume and calculation of total glass used along with potential savings at different tonnage trial. Bacardi alone, off trade, is expected to deliver between 202 tonnes (at 10%) and 605 tonnes (at 30%) of glass savings (Table 7-6 - Mintel, White Spirits UK, March 2005).

Table 7-6: Break down of glass weight savings; White Rum (2004)
Source: Mintel, White Spirits UK, March 2005

White Rum	Sales Volume from 70cl bottles (2004) m litres [27]	No. Of 70cl Bottles (m)	Weight per (70cl) Bottle Weight (g)	Total Weight (Tonnes)	Tonnage Trial		
					10%	20%	30%
Bacardi	4.40	6.29	425	2,671.43	267.1	534.286	801.429
Other Brands (7.6%) and own labels (22.4%)	1.89	2.70	425	1,148.71	114.8	229.742	344.613
Total Market Size (2004)	6.29	8.99	425	3,820.14	382.01	764.028	1146.042
Off Trade; Bacardi (75.5%)*	3.32	4.75	425	2,016.93	201.69	403.386	605.079
On Trade; Bacardi (24.5%)*	1.08	1.54	425	654.50	65.45	130.9	196.35
Off Trade (Other brands 7.6% and own labels 22.4%)*	1.43	2.04	425	867.28	86.73	173.456	260.184
On Trade (Other brands; 7.6% and own labels 22.4%)*	0.46	0.66	425	281.44	28.14	56.288	84.432
Off Trade (Total Market)	4.75	6.79	425	2,884.21	288.42	576.842	865.263
On Trade (Total Market)	1.54	2.20	425	935.94	93.59	187.188	280.782

7.7.3 Vodka

Vodka dominates the white spirit category with about 57% of total white spirits market by sales volume. According to GVA (Gin and Vodka Association) it is estimated that around 16% of the vodka sold in the UK is imported. With regard to distribution, about 68% of the vodka is purchased from off trade and on trade accounts for 32% of the vodka market by sales volume. The trend towards home drinking is spreading across the drinks categories and likely to continue in future.

In respect of the vodka brands, Smirnoff was found to be the dominant brand with 42% market share, followed by Vladivar and Glen's with 16% and 11.5% market share respectively. The remaining players within this market were smaller brands (14.4%) including own labels (9.6%). Taken together, these three brands are expected in off- trade sales, to deliver between 725 tonnes (10% trial) and 2,176 tonnes (30% trial) glass savings as shown (Table 7-7, Mintel, White Spirits UK, March 2005). It should be noted that based on the supermarket audit conducted by LUBS during summer 2005, bottles of Smirnoff and Vladivar were found to be produced in the UK. However, the source of bottles production in the case of Glen's could not be traced and needs to be confirmed before further consideration.

[27] Based on "Total Sales Volume" (Source: Mintel; White Spirits-UK-March 2005). In line with the James Ross Study for 70cl Whisky bottle, the sales volume of 70cl bottles has been estimated at 44% of the total sales volume (Mintel-white Spirit UK-March-2005)

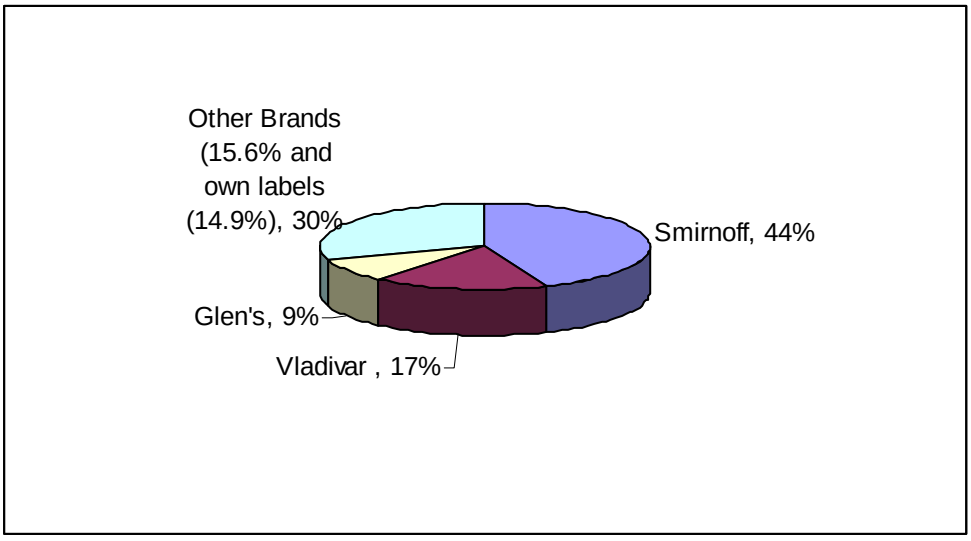
* Source: Mintel; White Spirit-UK-March 2005

Table 7-7: Break down of glass weight savings; White Spirit- Vodka (2004)
Source: Mintel: White Spirits-UK-March 2005

Brand	Sales Volume (70cl bottles) M litres	No. Of 70cl Bottles (m)	Weight per Bottle	Total Weight (Tonnes)	Tonnage Trial		
					10%	20%	30%
Smirnoff	11.04	15.78	420	6,626.40	662.64	1,325.28	1,987.92
Vladivar	4.22	6.03	435	2,624.91	262.49	524.98	787.47
Glen's	3.04	4.34	330[29]	1,431.26	143.13	286.25	429.38
Sub Total	**18.30**	**26.15**	**N/a**	**10,682.57**	**1,068.26**	**2,136.51**	**3,204.77**
Other Brands (15.6%) and own labels (14.9%)	8.01	11.44	405	4,518.80	451.88	903.76	1,355.64
Total Vodka (2004)	**26.31**	**37.59**	**n/a**	**15,201.37**	**1,520.14**	**3,040.27**	**4,560.41**
Off Trade (Top three brands)	12.43	17.75	n/a	7,253.47	725.35	1,450.69	2,176.04
On Trade (Top three brands)	5.88	8.39	n/a	3,429.11	342.91	685.82	1,028.73
Off trade (Other Brands including Own Labels)	5.44	7.77	405	3,068.27	306.83	613.65	920.48
On trade (Other Brands including Own Labels)	2.57	3.67	405	1,450.53	145.05	290.11	435.16
Off Trade (Total Market)	17.87	25.52	n/a	10,321.73	1,032.17	2,064.35	3,096.52
On Trade (Total Market)	8.45	12.07	n/a	4,879.64	487.96	975.93	1,463.89

The figure following (Figure 7-8: Source: Mintel, White Spirits UK, March 2005) clearly highlights the two key brands, Smirnoff and Vladivar which account for 61% of glass packaging weight in this sector representing targets for glass reduction.

Figure 7-8: Weight Distribution Vodka, 70cl bottles – UK (2004)
Source: Mintel, White Spirits UK – March 2005



[28] Source: Mintel: White Spirits-UK-March 2005
[29] Source: Based on the information collected from Steering Group Member; Glass Manufacturer.

7.8 Whisky

UK retail sales volume of whiskies was estimated to be £2953 by value and 90.6 m litres by volume in 2004 (Mintel, Whiskies UK, August 2004). Though the malt sector in the UK has reported a good growth in past few years, the UK whisky market is still dominated by blended whisky with about 77% volume share (Mintel; Whiskies-UK-August 2004). It should be noted that in spite of an average growth of approximately 3% from 1999 to 2004, the UK whisky market is struggling to maintain its sales value and volume with an expected decline of about 9% in next five years (Mintel, Whiskies UK, August 2004).

The key brands by both sales volumes in litres and bottles are Bells and Famous Grouse. However the market is largely made up of numerous smaller brands and retailer own labels accounting for 67% of this market. The on-trade / off-trade split is around 45% to 55% illustrating the trends identified towards home consumption of alcoholic drinks.

In terms of packaging, whisky is available in various bottle sizes and shapes ranging from generic round design to rectangular, square, and bespoke designs. The focus of the study is on the standard size of 70cl bottles that accounts for about 44% of the total sales volume (James Ross Consulting Ltd, 2005). With this approximation and a total sales volume of 90.6 m litres (Mintel; Whisky-UK- August 2004), the total whisky sales from 70cl bottles can be estimated at 39.86 m. litres with total number of 70cl bottles at 56.94 million. If the sales volume figures (total whisky sales volume at 68 m litres with 44% from 70cl bottles) from James Ross's study is taken into account, the total number of 70cl bottles can be estimated at 42.3m units with total glass weight of 21,654 tonnes (James Ross Consulting Ltd, 2005). The weight of 70cl whisky bottles ranges from 334gm to 625gm per bottle depending upon shape and design of the bottle. Generally speaking, rectangular and square bottles have been found to be heavier than that of generic round type bottles. A comprehensive study by James Ross Consulting on 70cl whisky bottles identified the "best in class" whisky bottles of 334gm and if the entire category is moved to "the best in class" category, an average glass weight saving can be up to 92gm per bottle which can yield the total glass savings in the range of 2,950 tonnes (70cl blended whisky bottles 31.7 m) to 3,892 tonnes (70cl total whisky bottles; 42.3 m) per annum (James Ross Consulting Ltd., 2005).

However, it is very difficult to move the whole category to the "best in class" category of 334gm bottles. It should be noted that because of the link between perceived brand image, product quality and the package type/design/weight, brand owners may prefer not to go for major changes in their bottle designs and shapes. However, they may agree to a reasonable amount of glass light weighting if the shape and design of the bottle is maintained

Table * below illustrates the potential glass weight savings calculated at three (10%, 20% and 30%) different tonnage trials at brand levels, with on trade and off trade splits. Wherever possible, an attempt has been made to estimate the glass weight savings at category, brand and distribution (off / on trade) level, so as to present the comprehensive and clear picture in assessing the best potential brands for light weighting selection.

*Table *: Break down of glass weight savings; Whisky (2003)*
Source: Mintel, Whiskies-UK-August 2004

Brand	Sales Volume (2003) m litres[30]	No. Of Bottles (m)	Weight per Bottle (g)	Total Weight (Tonnes)	Tonnage Trial		
					10%	20%	30%
Bells	5.28	7.54	420	3,168.00	316.80	633.60	950.40
Famous Grouse	5.19	7.42	398	2,952.02	295.20	590.40	885.61
Grants	2.73	3.90	528	2,057.69	205.77	411.54	617.31
Sub TOTAL	13.2	18.86	n/a	8,177.71	817.77	1,635.54	2,453.31
Other Brands (39%) including own labels (27.1%)	25.74	36.77	449	16,498	1,649.81	3,299.62	4,949.43
Total Market	38.94	55.63	n/a	24,675.82	2,467.58	4,935.16	7,402.75
Off Trade (Others and Own Label)	14.16	20.22	n/a	9,073.96	907.40	1,814.79	2,722.19
On Trade (Others and Own Labels)	11.58	16.55	n/a	7,424.15	742.41	1,484.83	2,227.24

[30] Sales Volume of 70cl bottles which has been estimated at 44% of the total sales volume (Based on James Ross Consulting Ltd., 70cl Whisky bottles Study).
Source: (Total Sales Volume) Mintel; Whiskies-UK-August 2004

Off Trade (Top three; 70cl)	7.26	10.37	n/a	4,497.74	449.77	899.55	1,349.32
On Trade (Top three; 70cl)	5.94	8.49	n/a	3,679.97	368.00	735.99	1,103.99
Off Trade Total	21.42	30.60	n/a	13,571.7	1,357.17	2,714.34	4,071.51
On Trade Total	17.52	25.03	n/a	11,104.12	1,110.41	2,220.82	3,331.23

Table * above indicates the key brands for potential glass light weight savings in this market. The top 3 brands have the potential to deliver in the range of 818 (10%) and 2,453 (30%) tonnes. Significantly it is the own label category that offers the potential of the largest savings and requires further investigation and assessment.

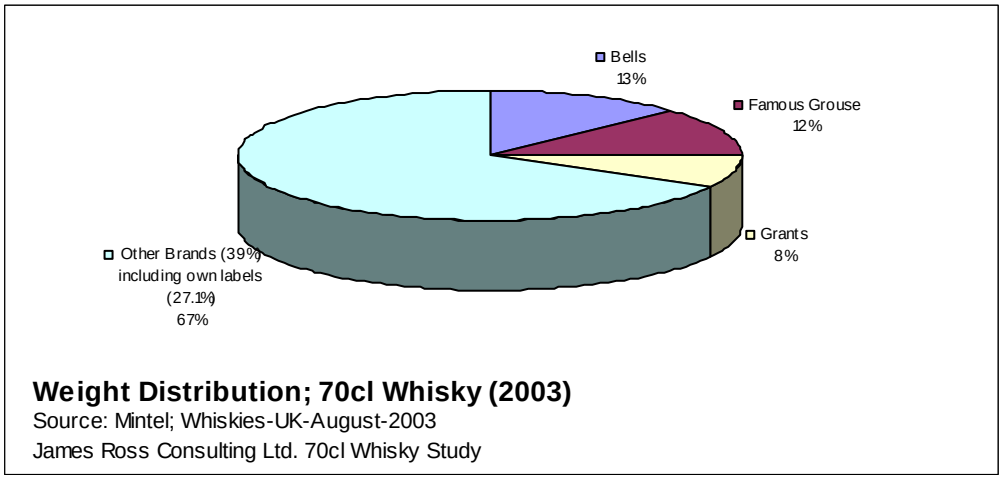


Figure *

The pie chart graph 16 above, clearly illustrates the brands that will potentially offer the best targets for weight reduction in the whisky sector with 43% of the total weight of 70cl bottles accounted for by the three brand leaders. However the strength of the own label, which dominates this sector with 28% share of glass weight and the potential of generic bottles across retailer labels, makes this segment of the whisky sector an attractive prospect.

7.9 Dark Spirit

The dark spirit market is growing at a steady pace (1-2%) and was valued at £700 million or 27.7 m litres in 2004. The market by value is split approximately 75% brandy and 25% dark rum. Sales of brandies and cognacs have declined by almost 20% over the last 20 years, but have recently rallied. The leading brands of brandy by volume are Courvoisier, Martell, and Three Barrels, with the market share of 25.7%, 24% and 10% respectively. The total brandy market was valued at £500 m in 2004. For the purpose of this audit phase, and given the relatively smaller volumes in this category, only the lead brand has been selected for analysis. As Table 7-8 illustrates Courvoisier is expected (off trade) to deliver glass savings of between 130 tonnes (at 10%) and 389 tonnes (at 30%).

Table 7-8: Break down of glass weight savings; Dark spirits (2004)
Source: Mintel Dark Spirits UK, April 2005

Brand	Sales Volume (2004) m litres[31]	No. Of Bottles (m)	Weight per Bottle (g)	Total Weight (Tonnes)	Tonnage Trial		
					10%	20%	30%
Courvoisier	2.24	582	1865.73	1,865.73	186.57	373.15	559.72
Sub TOTAL	2.24	n/a	1865.73	1,865.73	186.57	373.15	559.72

[31] Source: Mintel: Dark Spirits-UK-April- 2005. Sales volume figures indicates sales volume from 70cl bottles. In line with the James Ross study for 70cl whiskies bottles, 44% of the total sales volume (by litres) has been estimated from 70cl bottles.

Other Brands (53.8%) own label (20.5%)	6.56	582	5,450.85	5,450.85	545.08	1,090.17	1,635.25
Total Market (70cl bottles)	8.80	n/a	n/a	7,316.57	731.66	1,463.31	2,194.97
Off Trade 69.5%[32] (Courvoisier)	1.56	n/a	n/a	1,296.68	129.67	259.34	389.00
On Trade 30.5% (Courvoisier)	0.68	n/a	n/a	569.05	56.90	113.81	170.71
Off Trade Total 69.5%	4.56	n/a	n/a	5,085.02	508.50	1,017.00	1,525.51
On Trade Total 30.5%	2.00	n/a	n/a	2231.55	223.16	446.31	669.47

Dark rum, by contrast is a somewhat smaller market segment, still growing slowly and valued at £ 208 m in 2004. The leading brands by volume are Captain Morgan (27.1%), Morgan Spiced (25.7%) and Lamb's Navy (18.6%). No precise data was available regarding on trade and off trade for this specific category, but an assumption of 35% off trade and 65% on trade (in line with the majority of white spirits) is made here.

7.10 Wine

A.C. Nielsen 2004 estimates the total UK wine market by volume to be 820 million litres, 86% of which is packed in 750 ml bottles. The off-trade accounts for 83% of the total sales by volume reflecting the trends towards greater home consumption of alcohol. The majority of these bottles are sold through grocery multiples (586m litres) which equates to 781m 750ml bottles.

Table 7-9: Wine Sales by country of origin
Source James Ross Consulting

	% of total UK market	No. Bottles	Ave. Bottle Wt (g)
America's	22.6%	211,977,896	521.4
Aus/NZ	23.2%	217,605,628	515.0
Europe	44.2%	414,576,240	481.4
S. Africa	10.0%	93,795,529	520.4

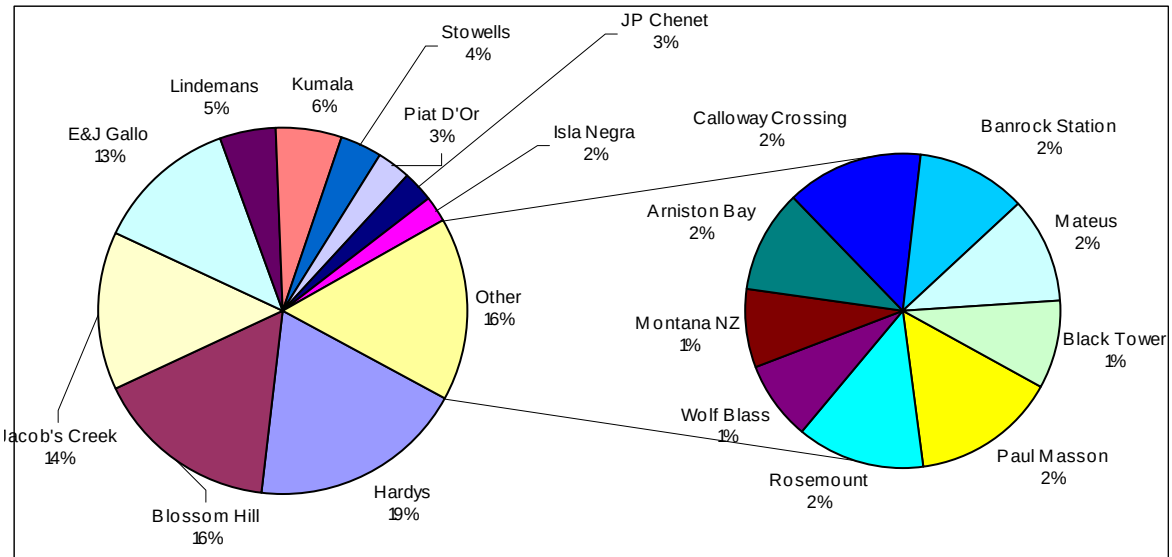
Table 7-8 above illustrates the country of origin of wine production and highlights the market shares dominated by European traditional producers but shows the increasing prominence of new world producers. Clearly most wine production in the UK is imported with English produced wine accounting for only 1% of the total UK volume sales. However some brands are being bottled in the UK (e.g. variants Echo Falls and Stowells) and some UK based companies own wine brands, for example Diageo who own Blossom Hill.

Table 12 shows the volume and unit sales figures for the top 10 UK wine brands dominated by Blossom Hill and Hardys closely followed by E&J Gallo and Jacobs Creek. The top ten wine brands account for 275m litres which is 20% of the total market. In terms of volume in litres, Hardys dominate, where as in unit bottle sales Blossom Hill is just ahead of Hardys. The average bottle weights vary considerably across the leading brands from 432gms for Blossom Hill to 588gms for Kumala. The average weight for the top ten selling brands is 502gms.

Table 7-10: Top 10 Wine Volume and Unit sales (750ml) UK (2005)[33]

[32] On trade:off trade split has been estimated at 30.5:69.5 (Source; Mintel; Dark Spirits-UK-April-2005
[33] Source: AC Nielsen

Wine Brand Family	Volume (Litres in Actual)	Units (750 ml) Bottles in Actual)	Estimated total glass bottle weight (tonnes)	Average individual glass bottles weight (g)
Blossom Hill	28,935,466	38,579,497	16,666	432
Hardys	28,136,353	37,504,902	19,390	517
E&J Gallo	20,437,225	27,244,152	13,050	479
Jacob's Creek	20,040,552	26,606,933	14,900	560
Kumala	7,800,291	10,211,682	6,004	588
Lindemans	7,663,837	10,203,359	5,173	507
Stowells	5,937,576	7,916,771	3,943	498
Piat D'Or	4,703,209	6,270,712	3,198	510
JP Chenet	4,216,005	5,621,255	2,794	497
Isla Negra	3,875,993	5,167,986	2,238	433



Graph 17: Weight Distribution; Wine (Off Trade; 2005)
Source: AC Nielsen: UK off-trade w ine sales: Top SKU's

Figure 7-9: Percentage of total glass weight
Source: AC Neilson UK off trade wine sales

The above graph 17 illustrates the weight distribution of off-trade wine. This shows Hardys, with more unit bottle sales and a considerably heavier bottle at 517gms commands 19% of the market by glass weight, despite being second to Blossom Hill in volume sales. Other heavier bottles from Jacobs Creek (560gms) and Kumala (588gms) influence these brands higher representation on the graph.

Table 7-11: Break down of potential glass weight savings; Bottled Wine; (750ml Bottle 2005)[34]
Source: AC Nielsen: UK off-trade wine sales: 11/2004-10/2005.

Wine Brand Family	Volume (Million Litres)	Units (750 ml) Bottles in Million)	Average individual glass bottles weight (g)	Estimated total glass bottle weight (tonnes)	Tonnage Trial		
					10%	20%	30%
Hardys	28.14	37.50	517	19,390.03	1939.00	3878.01	5817.01
Blossom Hill	28.94	38.58	432	16,666.34	1666.63	3333.27	4999.90
Jacob's Creek	20.04	26.61	560	14,899.88	1489.99	2979.98	4469.96
E&J Gallo	20.44	27.24	479	13,049.95	1304.99	2609.99	3914.98
Kumala	7.80	10.21	588	6,004.47	600.45	1200.89	1801.34
Lindemans	7.66	10.20	507	5,173.10	517.31	1034.62	1551.93
Stowells	5.94	7.92	498	3,942.55	394.26	788.51	1182.77
Piat D'Or	4.70	6.27	510	3,198.06	319.81	639.61	959.42
JP Chenet	4.22	5.62	497	2,793.76	279.38	558.75	838.13
Isla Negra	3.88	5.17	433	2,237.74	223.77	447.55	671.32
Total Top Ten (off Trade)	131.75	175.33	5,021	87,355.90	8735.59	17471.18	26206.77
Other Nine Brands; Off Trade)	24.89	33.17	4,562	16,825.36	1682.54	3365.07	5047.61
Total Off Trade Top (Nineteen Brands)	**156.64**	**208.50**	**9,583**	**104,181.26**	**10418.13**	**20836.25**	**31254.38**
Total Top Ten (off Trade)	131.75	175.33	5,021	87,355.90	8735.59	17471.18	26206.77
Other Nine Brands; Off Trade)	24.89	33.17	4,562	16,825.36	1682.54	3365.07	5047.61
On Trade (Top Ten Brands)	25.06	33.36	1,533	16,669.00	1666.90	3333.80	5000.70
On Trade (Other Nine Brands)	4.77	6.35	292	3,175.05	317.50	635.01	952.51
Total On Trade (Top Nineteen Brands)	**29.84**	**39.71**	**1,825**	**19,844.05**	**1984.40**	**3968.81**	**5953.21**
Total Wine (Top 19 Brands)	**186.48**	**248.22**	**11,408**	**124,025.31**	**12402.53**	**24805.06**	**37207.59**

Table 13 presents the breakdown of potential glass weight savings. The market leaders dominate with 7% of the total market and the top ten brands could deliver between 8736 tonnes at 10% reduction to 26,207 tonnes at 30%. The projected figures for UK wine sales highlights the potential weight savings with a prediction for off-trade savings on the top 19 brands of 12875 tonnes at 10% and 38626 tonnes at 30% by 2009. As discussed the wine section was included due the high level of its off-trade sales and its future potential as a sector.

7.11 Conclusion

The overall objective of this research was to identify the key branded products that could be considered to be the most effective targets for glass packaging light weighting.

[34] Source: AC Nielsen: UK off-trade wine sales: Top SKU's (Period: 11/2004-10/2005). Includes top Nineteen Brands (750 ml) only.

The analysis contained within this audit report has resulted in the identification of total_39 brands across the key market sectors originally identified for assessment. (alcoholic spirits, beers, FAB's together with coffee and sauces). The inclusion of a wine sector was due to its dominant position as an off-trade alcoholic beverage despite the high levels of imports there are trends towards bottling new world wines closer to the market, rather than at source. For example Stowells Cabernet Merlot and Echo Falls Classic are both packaged in bottles manufactured in the UK by Rockware Glass. It is also important to recognise that some wine brands are owned by UK companies, such as Diageo (Blossom Hill) and could still influence brand packaging manufactured outside the UK. It was therefore considered appropriate to address the significance and potential of this sector.

Analysis, primarily using secondary data reports and supermarket audits and information supplied by consortium members have led to a proposed list of 30 (glass packaged) branded product lines for potential light-weighting evaluation. An attempt has also been made to remove the brands known to be produced outside the UK. However, in few of the cases (Becks, Bacardi Breezer, Carlsberg Export, Glen's and Bombay Sapphire) it was difficult to determine the exact source of production due to ambiguous and/or unclear glass punt markings. In such cases the brands have been included in Table 7-10 below for the further consideration.

A summary in Table 7-10 (following) pulls together the category areas at brand level and has been arranged in descending order in terms of potential glass weight savings in 2005. The potential glass weight savings in 2009 have also been included for additional information. This table reveals that potential glass savings across these 30 brands could be estimated in the range of 65563 to 196688 in 2005 and predicted to be 84978 to 254934 in 2009. However it should be noted that the source of production of some of the brands could not be identified and if we exclude these 5 brands from the list of 30, the potential glass weight saving can be expected in the range of 51113 to 154291 tonnes in 2005 and in the range of 65889 to 197668 tonnes in 2009.

Table 7-12: Top 30 brands by weight

		Glass Weight (2005)			Tonnage Trial (2005)			Glass Weight (2009)			Tonnage Trial (2009)		
Brand	**Brand owner**	**Off Trade**	**On Trade**	**Total**	**10%**	**20%**	**30%**	**Off Trade**	**On Trade**	**Total**	**10%**	**20%**	**30%**
Stella Artois (330ml)	InBev	51753	84439	136192	13619	27238	40858	59516	97105	156621	15662	31324	46986
Grolsch (300 ml)	Coors	25999	42419	68418	6842	13684	20526	29899	48783	78682	7868	15736	23604
Budweiser (330 ml)	AB	24580	40104	64684	6468	12937	19405	28266	46118	74384	7438	14877	22315
Smirnoff Ice (275 ml)	Diageo	24175	27261	51436	5144	10287	15431	24175	27261	51436	5144	10287	15431
WKD (275 ml)	Bev. Brands	22406	25267	47673	4767	9535	14302	22406	25267	47673	4767	9535	14302
Kronenbourg 1664 (300ml)	Scotco	16057	26198	42255	4226	8451	12677	18466	30129	48595	4859	9719	14578
Beck's (275ml)	InBev	9554	15588	25142	2514	5028	7543	11178	18238	29416	2942	5883	8825
Hardys (750ml)	BRL Hardy	19390	3693	23083	2308	4617	6925	23963	4564	28527	2853	5705	8558
Carlsberg Export (330 ml)	Carlsberg	8771	14311	23082	2308	4616	6924	10087	16458	26545	2654	5309	7963
Bacardi Breezer (275ml)	Bacardi Martini	10507	11849	22356	2236	4471	6707	10507	11849	22356	2236	4471	6707
MGD (330 ml)	SAB Miller	8170	13330	21500	2150	4300	6450	9395	15329	24724	2472	4945	7417
Blossom Hill (750ml)	Diageo	16666	3174	19840	1984	3968	5952	20597	3923	24520	2452	4904	7356
Carlsberg (275ml)	Carlsberg	7403	12079	19482	1948	3896	5844	8513	13890	22403	2240	4481	6721
Jacob's Creek (750ml)	OW Group	14900	2838	17738	1774	3548	5321	18414	3507	21921	2192	4384	6576
Nescafe Original (200 gm)	Nestle	0	0	17253	1725	3451	5176	0	0	18619	1862	3724	5586
E & J Gallo (750ml)	E.&J. Gallo	13050	2486	15536	1554	3107	4661	16128	3072	19200	1920	3840	5760
Starberg (250ml)	Netto	5526	9016	14542	1454	2908	4363	6354	10367	16721	1672	3344	5016
Reef (275 ml)	Coors	6153	6938	13091	1309	2618	3927	6153	6938	13091	1309	2618	3927
Homepride (500 gm)	Campbell	0	0	13067	1307	2613	3920	0	0	14684	1468	2937	4405
Red Square (275 ml)	Halewood Int.	5768	6505	12273	1227	2455	3682	5768	6505	12273	1227	2455	3682
Nescafe Original (100 gm)	Nestle	0	0	10226	1023	2045	3068	0	0	10733	1073	2147	3220
Archer's Aqua (275 ml)	Diageo	4273	4818	9091	909	1818	2727	4273	4818	9091	909	1818	2727
Smirnoff (70cl)	Diageo	4859	2297	7157	716	1431	2147	7079	3347	10425	1043	2085	3128
Kumala (750ml)	Western	6004	1144	7148	715	1430	2144	7421	1414	8835	883	1767	2650
Lindemans (750ml)	Lindemans	5173	985	6158	616	1232	1848	6393	1218	7611	761	1522	2283
Daddies (340gm)	HP Foods	0	0	6060	606	1212	1818	0	0	6540	654	1308	1962
VK (275 ml)	GBL Int.	2692	3035	5727	573	1145	1718	2692	3035	5727	573	1145	1718
Stowells (750ml)	Constellation	3943	751	4694	469	939	1408	4872	928	5800	580	1160	1740
Sharwood's (420 gm)	Centura foods	0	0	4452	445	890	1336	0	0	5215	522	1043	1565
Piat D'Or (750ml)	Diageo	3198	609	3807	381	761	1142	3952	753	4705	470	941	1411
T O T A L (TOP 30 BRANDS)		**320971**	**361136**	**733164**	**73316**	**146633**	**219949**	**366467**	**404814**	**827072**	**82707**	**165414**	**248122**

Dissemination

The Activity 2 phase of the project as demonstrated in Diagram 1 of this report shows the planned programme of dissemination activities. From the start of the project dissemination of project principles was considered a vital element of the overall deliverables in efforts to mainstream light-weighting.

The objectives contained within the Activity 2 phase were:

1. Driving uptake across wider product ranges
2. Driving acceptance of light-weighted containers
3. Influence of suppliers
4. Wider production trials

These were achieved through a range of specific dissemination activities designed to reach a wide audience of potential stakeholders throughout the glass packaging supply chain.

7.12 One to one discussions

Whilst one to one meetings may be seen as a less time efficient method of reaching an audience than a conference presentation or press release, they were never-the-less an effective tool in engaging new contacts as it was possible to highlight aspects of the project of particular relevance. Especially effective were meetings at which examples of containers light-weighted during the project were presented as a practical demonstration of the project's achievements.

7.13 Conferences and Presentations

Presentations were made during the life of the project at which the Container Lite principles were used as a case study to demonstrate issues including sustainability, environmental awareness and packaging innovation. Presentations were made by both the core project team (British Glass and Faraday Packaging) and WRAP. Events where Container Lite was presented as a case study include:

- Glass Action – March 2006, Tankersley Manor, South Yorkshire
- Faraday Packaging Partnership Annual Stakeholder Conference – March 2006, Ripley Castle, North Yorkshire
- Packaging Design Summit – March 2006, Amsterdam
- Scottish Whisky Association – November 2005, Edinburgh
- Wine & Spirits Trade Association -

7.14 Workshops

To demonstrate the value of consumer perception testing prior to any proposed design amendment being implemented, the Psychology of Design Group ran workshops to present the methodology used during the project. Workshops were free of charge and open to attendance from a wide range of industrial representatives from design agencies to brand owners and retailers. A explanation and demonstration of some of the techniques used during Container Lite was provided to delegates.

7.15 Achieving further savings

The project's secondary target of achieving an additional minimum of 30,000 tonnes weight savings within 12 months of the project completion date has already been partly achieved within the current project as 20,000 tonnes saving has been realised by Quinn Glass in wine bottle manufacture. It is anticipated that the additional tonnes required will be realised via roll out of a generic container design across the whole industry.

Container Lite will continue to be used as a case study by British Glass and Faraday Packaging Partnership in promoting the positive environmental impact that can be achieved through light-weighting and the benefits available to industry in using a consortium based approach to the project.

8 Co-op

In response to a proposal that the Co-op submitted to WRAP under Round 4 of the Retail Innovation Fund requesting funding to look at a glass light-weighting project, it was recommended that this work be undertaken through the Container Lite consortium. The work programme looking at Co-op own brand whisky bottles and food containers was devised and comprised of:

- Store Audit and Analysis
- Consumer Perception Studies
- Manufacturing Trials

Work began in January 2006 and is due for completion in July 2006. A report detailing the work and results will be published following completion of the work.

9 Conclusions

The benefits associated with glass as a packaging material are numerous from both consumer and manufacturer/brand owner perspectives. Benefits include:

- premium image
- association with brand leaders
- ability to hot fill
- reusability / recyclability

Given these positive associations, the challenge for the glass industry is to maintain or increase current production levels whilst working towards reducing environmental impacts. Light-weighting of glass meets multiple environmental criteria including reduction in material use, reduction in CO_2 from production and transportation and reduction in landfill waste.

A number of key elements to delivering this change have been explored, defined and momentum developed towards change by this project, in particular.

✓ The production trials effectively demonstrated the technical capability of UK glass manufacturers in light-weighting and their willingness to proactively reduce the environmental impacts of their processes. At the same time, manufacturers have a duty to their customers to protect any brand identity whilst delivering cost effective manufacturing solutions. Given the scope for brand sensitivity to change, as demonstrated during the course of the project, the challenge for manufacturers is to maintain a positive dialogue with their customers around light-weighting within appropriate bounds.

✓ Consumer perceptions to light-weighted containers have, on the whole, been positive. Whilst the research has highlighted the need to take account of brand sensitivity, it has also shown that a brand is comprised of a series of elements and it may be possible to alter some of these individual elements without negatively affecting perceptions. The research has further shown that many consumers find it difficult to identify weight reductions of up to 20% and even if a difference is detected, there is not necessarily a negative perception of the container.

✓ The performance testing demonstrated that reducing the amount of glass per container requires greater technical capability to ensure glass flow is sufficient throughout the mould. This greater attention to manufacturing processes results in a more even glass flow and as such an inherently stronger containers. As a potential consumer perception of light-weighted containers is that they may be more likely to break, this outcome can be used to counteract these worries.

The UK produces approximately 2.5 million tonnes of container glass per year of which approximately 1.5 million tonnes is disposed of via landfill. Whilst light-weighting of a generic container may simplify the manufacturing process and have a significant impact across multiple retailers brands and issues regarding the filling process may less straightforward. At the same time, the Market Survey has demonstrated the impact that could be made through a limited number of key brands. However, issues regarding any amendment to the design of a branded container may be significant and in some cases, brand owners may be less willing to take a risk.

Overall it appears well within both technical capabilities and consumer acceptance to reduce container weight by at least 10% and in some cases up to 30% without detrimental effect. Whilst it is not claimed that all UK container glass can be affected by the findings of this study, clearly there is the potential to impact on a significant proportion when taking into consideration generic and branded markets.

British Glass will continue their role in collating production statistics for the UK container glass industry. Via this data they will be able to determine any further weight savings that may be achieved.

Whilst meeting the objectives developed at the start of the project, the project team have come to adopt the term *right-weighting* as a more appropriate description of the project goals as it takes into consideration production/filling and consumer related restraints.

10 Recommendations

This study has determined the technical and consumer based feasibility of light-weighting container glass and has identified the key product areas for focus in order to achieve maximum impact in terms of tonnes saved. It is recommended that:

- Future light-weighting projects should include the five product areas identified as giving the highest potential in terms of tonnes to be saved – these are: beers, spirits, wine, food and FAB's
- Industrial momentum towards light-weighting is maintained with those companies (manufacturers, retailers, brand owners etc) showing interest and enthusiasm for light-weighting encouraged
- Research to be undertaken in developing new technologies to assist light-weighting
- The value of "brand identity" and the sensitivity of this should not be underestimated and
- Consumer education programmes to be considered

Appendix A – Consumer Perception Study of Coors 300ml Grolsch Bottle

Appendix B – Report of Product Performance Testing